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Operations and Maintenance Manual for the Rocky Flats Groundwater Treatment Systems

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Acronyms and Abbreviations

DO	dissolved oxygen
DOE	U.S. Department of Energy
ETPTS	East Trenches Plume Treatment System
FC	Functional Channel
ft	foot
ft^2	square foot
ft^3	cubic foot
gpm	gallons per minute
GWIS	groundwater intercept system
HDPE	high-density polyethylene
H&S	health and safety
IHSS	Individual Hazardous Substance Site
ITS	Intercept Trench System
ITSS	Intercept Trench System Sump
LED	light emitting diode
M&M	Monitoring and Maintenance
MSPTS	Mound Site Plume Treatment System
O&M	operations and maintenance
PLF	Present Landfill
PLFTS	Present Landfill Treatment System
PPE	personal protective equipment
PVC	polyvinyl chloride
PZ	piezometer
RFS	Rocky Flats Site
RFWF	Rocky Flats Working File
Site	Rocky Flats Site
SPP	Solar Ponds Plume
SPPTS	Solar Ponds Plume Treatment System
VOC	volatile organic compound
ZVI	zero-valent iron

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1.0 Purpose

This operations and maintenance (O&M) manual describes the routine O&M of four groundwater treatment systems at the Rocky Flats Site (RFS; the Site). These facilities include the Mound Site Plume Treatment System (MSPTS), East Trenches Plume Treatment System (ETPTS), Solar Ponds Plume Treatment System (SPPTS), and Present Landfill (PLF) Treatment System (PLFTS). The locations of these systems are shown on Figure 1.

2.0 Scope and Applicability

This document contains instructions for the O&M of the MSPTS, ETPTS, SPPTS, and PLFTS and is applicable to all personnel performing work on these systems. This includes all routine maintenance, from visual inspections to raking media to replacing treatment media (at the first three systems listed above) and all other activities that constitute this type of maintenance. Not included are system replacement, removal, abandonment, significant changes to the design or intent of the systems, and maintenance of the groundwater intercept trenches (since they typically require no maintenance).

The MSPTS, ETPTS, and PLFTS are designed to treat groundwater containing volatile organic compounds (VOCs), while the SPPTS is designed to treat elevated nitrates and uranium.

The MSPTS, ETPTS, and SPPTS consist of a groundwater collection trench with a collection sump that feeds intercepted groundwater to the treatment cells. Under normal operations, the treatment cells are configured so that water flows through the cells in series for treatment, and then to the metering manholes/vaults for release to an infiltration or exfiltration gallery. Because of their similarities, the MSPTS, ETPTS, and SPPTS are collectively referred to herein as simply the "three similar systems."

The PLFTS consists of a manhole that collects water that issues from a seep at the east face of the PLF and from the north and south segments of the Groundwater Intercept System (GWIS) and an engineered riffle structure that aerates the water to volatilize VOCs. Treated water then flows to the Landfill Pond.

Several appendices are included to provide supporting information. Appendix A contains the Job Safety Analysis (JSA) for routine inspection and maintenance operations at the treatment systems. Appendix B provides as-built drawings of the groundwater treatment systems. Appendix C contains information and tips for general solar pump system maintenance. Appendix D includes specifications on the zero-valent iron (ZVI) used in the treatment cells. Appendix E contains a selection of photographs of media replacement activities. Appendix F contains a sample field inspection log used to document routine treatment system maintenance. Appendix G contains wiring information for the telemetry dataloggers.

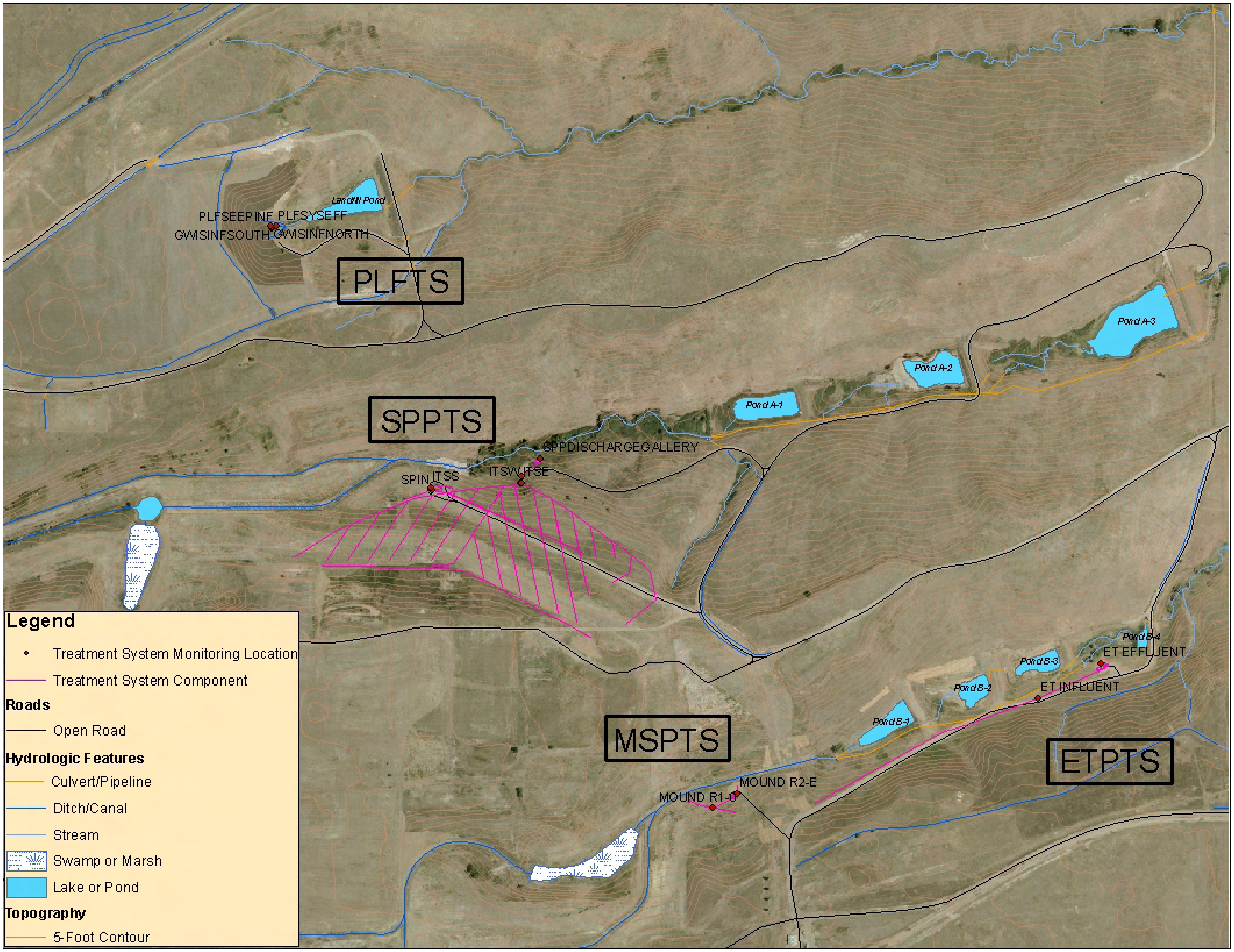


Figure 1. General Locations of Groundwater Treatment Systems at RFS

3.0 Routine Surveillance and Maintenance

Routine surveillance and maintenance of the four groundwater treatment systems at the Site shall be performed as described in Table 1. Note that the listed frequencies are minimums, and routine inspections (either of the systems themselves, or of telemetered data as discussed in Section 3.1.1) may indicate a need for more-frequent performance of maintenance activities.

Table 1. Routine Surveillance and Maintenance of RFS Treatment Systems and Instrument Vaults

Activity	Frequency[a]	MSPTS	ETPTS	SPPTS	PLFTS
Check water levels in treatment cells and collection sump (Section 3.3.1)	Weekly	✔	✔	✔	
Check manholes/vaults for flow rates/flow meters/flumes (Section 3.2)	Weekly	✔	✔	✔	
Calibrate manhole flow meter/clear flow meter flume (Section 3.2)	Monthly	✔	✔		
Check valves and piping (Section 3.3.2)	Biannually	✔	✔	✔	
Clean influent lines (Section 3.5.1)	Annually				✔
Clean effluent lines (Sections 3.3.2.1 and 3.5.1)	Annually	✔	✔		✔
Conduct routine raking/puncturing of pea gravel/iron mixture (Section 3.3.3)	Weekly	✔	✔		
Replace treatment media (Sections 3.3.7 and 3.4.4)[b]	As necessary	✔	✔	✔	
Check solar pump, panels, and charging system (Sections 3.4.1.3 and 3.4.2.1)	Weekly			✔	
Check voltages and currents on solar system (Sections 3.4.1.3 and 3.4.2.1)	Semiannually			✔	
Check flow rates in instrumentation vault (Sections 3.3.4 and 3.4.1.2)	Weekly	✔	✔	✔	
Check and clean filters in instrumentation vault (Sections 3.3.4 and 3.4.1.2)	Weekly	✔	✔	✔	
Check data transmission (Section 3.1)	Weekly	✔	✔	✔	
Check and document instrument calibration (Section 3.1)	As necessary	✔	✔	✔	
Check automated data output for indications of abnormal behavior (Section 3.1)	Weekly	✔	✔	✔	
Adjust flow rates based on automated data (Section 3.3.4.1)	As necessary	✔	✔		

[a]Listed frequency is minimum requirement. If inspection indicates more frequent action is appropriate, increase frequency accordingly.

Routine operations shall be fully and immediately documented in the field in the Monthly Inspection Log (Appendix F), and the Rocky Flats maintenance log on the Condor server shall be subsequently updated (\\Condor\Projects\ESL\VDV\SOARS\User Files\Activity Logs). Field personnel may choose to utilize a different method to record operations in the field (e.g., log book, PDA); regardless of the method employed it is important to include all information contained in the Monthly Inspection Log (Appendix F).

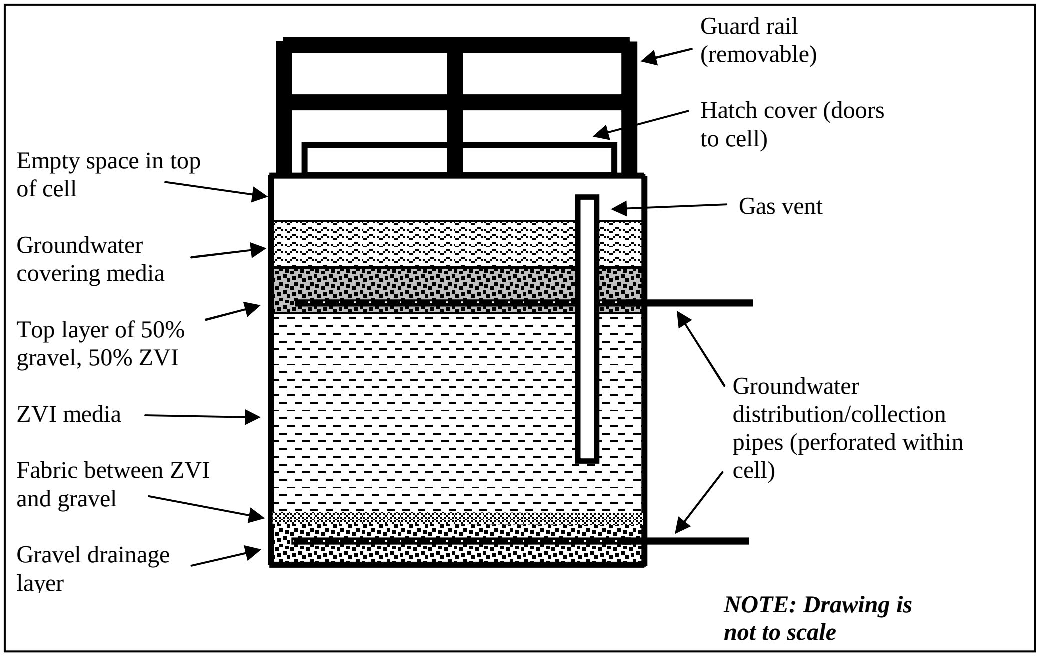
For the three similar systems, the effectiveness of the treatment cells is strongly influenced by the permeability of the media. At the MSPTS and ETPTS, this is adversely affected by the high dissolved oxygen (DO) content that is typical of Rocky Flats groundwater (which causes the ZVI to oxidize and form iron oxide and oxyhydroxide precipitates that can armor or clog the ZVI) and the dissolved ions in the groundwater (particularly calcium, Ca, and carbonate, CO_3, which result in calcium carbonate and iron carbonate precipitates that can have the same result). The sawdust media that is currently used to treat nitrate in the SPPTS does not appear to be significantly affected by the oxidizing groundwater, nor the dissolved ions entering this system. However, in the spring of 2009, a ZVI cell will be installed upgradient of the original two SPPTS treatment cells, and will therefore be receiving untreated water with similar DO, Ca, and CO_3 content. This ZVI cell will need to be monitored carefully for indications of clogging.

When operating in a downflow configuration, the groundwater flowing through the MSPTS and ETPTS treatment cells can cause surface crusting that periodically must be broken up to ensure an even flow across the entire surface of the treatment cell. (Crusting may also occur when these systems are operating in the upflow configuration; however, the crust is not accessible and cannot be broken up during routine maintenance activities.)

At the SPPTS, proper system operation and required treatment of the groundwater depends on the use of two energized pumps. Therefore, each of the three similar systems must be routinely inspected and maintained to ensure proper operation and continued groundwater treatment.

Additionally, the MSPTS, ETPTS, and SPPTS are supported by automated instrumentation that monitors such parameters as flow rate, water pressure, water levels, and battery voltages (SPPTS only). These instruments are located in a vault adjacent to the treatment cells and must be checked, and in some cases maintained, periodically. The SPPTS includes a second vault located near the Intercept Trench System (ITS) Sump (ITSS), which contains the batteries and controllers for that pump system. The effluent sampling location (SPOUT) for the SPPTS is also located in this vault. (The original effluent monitoring location that was located in the manhole adjacent to the SPPTS treatment cells, SPPMM01, is no longer used.) The engineered riffle surface of the PLFTS is a much simpler system that requires much less in the way of maintenance.

Figure 2 provides a conceptual cross-section of a treatment cell at the MSPTS or ETPTS. Cells at the SPPTS are very similar, especially the soon-to-be-installed ZVI cell at the SPPTS, with several differences as described in the notes to this figure.



Notes: This representation is conceptual only. See Appendix B for as-built drawings.
Groundwater enters from the collection trench or from the other cell (not shown). In upflow configuration, the lower pipe is the distribution pipe, and the upper pipe is the collection pipe; the opposite is true in downflow configuration.
At the SPPTS, the media in what is currently Cell 1 is sawdust with ZVI, and in Cell 2 is gravel with ZVI; these media are buried under approximately 12 ft of wood chips and soil overburden. The plumbing also differs somewhat, although the concepts are the same; see Appendix B.

Figure 2. Schematic of a Treatment Cell at the ETPTS or MSPTS

Table 2 presents typical ranges (following Site closure in October 2005) for water levels in the treatment cells for the systems, as well as anticipated flow rates for normal operations. Flow rates for pre-closure conditions are not included because the volume and distribution of groundwater was so strongly controlled by the presence of leaky utilities, impermeable surfaces (buildings, parking lots, roads, and so forth), and, as closure progressed, the addition of dust-suppression water. (These perturbations of the hydrologic system may still have an effect, but may no longer be of large significance.) In addition, closure efforts included routing subsurface flow from a utility corridor immediately west of the MSPTS (draining former Oil Burn Pit No. 2, i.e., Individual Hazardous Substance Site [IHSS] 153) into the MSPTS intercept trench, increasing flow rates and contaminant concentrations at that system relative to those typical of the first 7 years of MSPTS operation.

Table 2. Typical Operating Ranges (Rounded) for Flow Rate and Depth to Water in Treatment Cells

Operating Parameters	Minimum	Maximum
Treatment System Flow Rate (gpm)		
MSPTS	0	2.3
ETPTS	0	2.5
SPPTS[a]	0 (SPIN) 0 (ITSS)	5.5 (SPIN) 17.5 (ITSS)
PLFTS	N/A	N/A
Depth to Water in Treatment Cells (in feet from the treatment cell doors)[b]		
MSPTS	1.5	4.5
ETPTS	0.8	2.7
SPPTS	N/A	N/A
PLFTS	N/A	N/A

[a]The SPPTS pumps at SPIN and ITSS do not operate continuously; flow rate oscillates between these two values several times per hour.
[b]The SPPTS and PLFTS are not equipped with treatment cell doors. Water level measurement is not applicable at the PLFTS, and is not routinely performed at the SPPTS.
gpm = gallons per minute
N/A = not available (not measured or not applicable to the corresponding system)

Each of the treatment systems may show higher flow rates than those shown above if there was a recent heavy precipitation event. The flow rates and water levels listed in Table 2 are based on data collected through late-2008, and reflect a wide range of conditions. These values are provided only as a general observation; while values outside of these ranges are usually cause for significant concern and require closer examination, values falling within these ranges do not necessarily signify proper treatment system functioning. Sudden changes observed in any of the above parameters will require closer examination of both the treatment system and the automated data in order to determine the cause.

Flow rates at the flume in the MSPTS and ETPTS (the SPPTS has a flume, but no flow meter is connected to it) may be artificially (erroneously) increased if there is an obstruction in the flow meter flume; such obstructions shall be removed at least monthly. Reported flow rates must be corrected for any systematic errors that may be discovered (such as obstructions in the flume). Water levels above those listed may indicate flow through the treatment media is obstructed, potentially requiring that the media be replaced. High water levels may also be a natural, temporary response to precipitation events, or can be an indication of fouling in the effluent plumbing for that cell or the system as a whole.

3.1 Telemetry, Instrumentation, and Data Transmission

3.1.1 Telemetry and Data Transmission

Data from instruments at treatment systems are collected on a datalogger and automatically transmitted at least daily to a computer at the Grand Junction office. A software program (Vista DataVision) reads in the data and automatically updates graphs. The graphs are available online via a password-protected website (https://soars.lm.doe.gov/) and should be checked at least once weekly to make sure they are being updated and no anomalous conditions exist. This requires access to the Internet and does not require a visit to the instrumentation vault. If data on the graphs are not current or are obviously in error, inform appropriate project personnel. Wiring diagrams for the dataloggers at each system are included in Appendix G.

IF automated data are not being updated for all treatment systems,
THEN check for obvious problems at the router (located on the pediment between the A and B-series ponds) such as loose wires, shaded solar panel, or blown-down antennas.

IF problem persists,
THEN contact appropriate project personnel for direction.

IF automated data are not being updated for a particular treatment system or instrument,
THEN check for obvious problems at the problematic telemetry station such as loose wires (at datalogger end or instrument end), shaded solar panel, blown-down antennas, or malfunctioning instrument.

IF problem persists,
THEN contact appropriate project personnel for direction.

3.1.2 Instrument Calibration and Troubleshooting

Instrumentation may occasionally require recalibration. When automated data differ from manually collected observations or otherwise indicate recalibration may be necessary, follow the calibration steps outlined in the manufacturers instructions for the instrument in question. Likewise, if instruments show any indication of malfunction, check manufacturer's instructions for troubleshooting recommendations. Manufacturer supplied literature is stored in the Rocky Flats Working File (RFWF), located on the share drive (\\robin\RF-Share\Rocky Flats Working File\Treatment Systems). Use the instrumentation overview spreadsheet (overview.xls) to determine which specific files to use.

3.1.3 Health and Safety Instrumentation

Certain procedures outlined in this manual may require entry into confined spaces; use of atmospheric monitoring instrumentation may be necessary. Calibration and operation instructions for the health and safety (H&S) instrumentation used at the Site can be found in the manufacturer supplied literature, located in the RFWF. Confined space entry requirements and procedures can be found in the *Health and Safety Manual* (LMS/POL/S04321, Standard 7.5) and the *Health and Safety Procedures Manual* (LMS/PRO/S04337).

3.2 Inspection and Maintenance of Manhole Flow Meters and Flumes

The effluent manhole flow meters at the MSPTS and ETPTS shall be calibrated at a frequency and in the manner described by the associated instruction manuals. The associated flumes shall be inspected on a weekly basis (simple visual check, no entry required), and cleared of any debris. The SPPTS no longer uses the flume in the manhole, but instead employs flow meters installed in the instrumentation vault (see also Section 3.3.4). Although entry of the SPPTS manhole for flume maintenance is no longer required, references to conditions that historically have been observed within that manhole are retained below in case entry is necessary. The

PLFTS is not equipped with a flow meter or flume. The frequency for flume inspection and maintenance is listed in Table 1.

Following are the steps for flow meter and flume inspection and maintenance. These steps may not require entry into the metering manholes. If entry is required, because the metering manholes containing the flumes are permit-required confined spaces they require the proper equipment, training, personnel, and paperwork for entry.

When entry is required, a minimum of two individuals are needed (one full-time attendant and one entrant). The attendant cannot perform ANY duties other than acting as attendant. There are to be NO EXCEPTIONS to this requirement, as the attendant must remain focused on the confined space entrant and nothing else. Therefore, three individuals are more commonly used, so that the attendant may act as full-time attendant for the entrant, and the third person can inspect the flow meter, perform documentation, trigger a purge of the bubbler line, and attend to other miscellaneous activities that the attendant is barred from performing because of the full-time requirement of being the attendant.

Note **If signs of rodent activity (e.g., nests, droppings, carcasses, or live rodents) are observed within any treatment system enclosures, do not enter the enclosure. Mouse droppings, saliva, and urine carry Hantavirus, which can cause a severe respiratory disease. Contact H&S immediately for instructions on proper handling and disposal.**

3.2.1 Remote Maintenance

Minor flume maintenance can be performed remotely, without entering the metering manhole. This maintenance is limited to clearing larger obstructions from the flume and performing general inspections. More thorough inspections and maintenance, including clearing the flow meter bubbler line and scrubbing out the flume, should not be performed remotely.

[1] Open the cover on the metering manhole and allow to ventilate for a minimum of 5 minutes.

Note **Poor air quality within the metering manholes is common. At the ETPTS, this often includes elevated levels of carbon monoxide. At the SPPTS, this may include insufficient oxygen.**

[2] Inspect the condition of the flume from the outside of the metering manhole.

[3] Gently remove any obstructions in the flume using a wooden pole or similar implement, taking care to prevent damage or potential dislocation of the flume, bubbler line, and other associated equipment.

[4] Close the cover on the metering manhole.

Note **It is very important to limit the amount of air entering the system. After completion of maintenance, make sure cell doors are completely closed and locked, and the system is isolated from outside air.**

[5] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

IF the above cannot be performed satisfactorily without entry into the metering manhole,
THEN enter the metering manhole as described below.

3.2.2 Maintenance through Confined Space Entry

Follow requirements for permit required confined space entry. The metering manhole contains treated groundwater; therefore, there is a low potential for harmful gases to be present in the system, or levels of oxygen to be reduced. Elevated levels of carbon monoxide have been detected in the past at these locations, primarily the ETPTS, and low levels of oxygen have been identified, particularly at the SPPTS. Therefore, monitoring the atmosphere prior to entry is required to verify that it is safe to enter.

[1] Open the cover on the metering manhole and allow it to ventilate for a minimum of 5 minutes. Using an appropriate multigas meter that has been freshly and properly calibrated, check the air quality within the manhole.

Note **Poor air quality within the metering manholes is common. At the ETPTS, this often includes elevated levels of carbon monoxide. At the SPPTS, there may be insufficient oxygen. Do not enter any metering manhole until acceptable air quality has been confirmed throughout, from the very top to the very bottom of the manhole.**

[2] Complete required confined space entry paperwork, properly don required safety equipment, and ensure attendant is appropriately trained. Attendant shall not perform any duty other than acting as confined space attendant.

IF work needs to be performed at the surface while the confined space entrant is in the manhole,
THEN a third individual needs to be present to perform this work. The attendant shall not perform any activity other than act as attendant throughout the confined space entry.

[3] Enter manhole using manufacturer's installed ladder.

Note **Continue to monitor air quality and confirm it remains acceptable throughout activities within the confined space. If air quality degrades, the entrant shall exit the manhole <u>immediately</u>.**

[4] Read water level on flume staff gage.

[5] Gently clean out flume and remove debris as necessary.

[6] Gently clear bubbler line and request flow meter inspector (third support individual other than attendant) trigger a purge of the line.

[7] Confirm proper operation of all components. Repeat actions as necessary to achieve proper operation.

[8] Exit manhole and doff safety equipment.

[9] Close cover on the metering manhole.

Note

It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.

[10] Dispose of debris as sanitary waste.

[11] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

IF obstruction persists,
THEN check for problems with valves and piping (Section 3.3.2).

3.3 Routine Surveillance and Maintenance of MSPTS and ETPTS

Because of the similarity between the MSPTS and ETPTS, routine surveillance and maintenance activities for these two systems are described together.

Note

If signs of rodent activity (e.g., nests, droppings, carcasses, or live rodents) are observed within any treatment system enclosures, do not enter the enclosure. Mouse droppings, saliva, and urine carry Hantavirus, which can cause a severe respiratory disease. Contact H&S immediately for instructions on proper handling and disposal.

3.3.1 Monitoring Water Levels

Water levels are manually measured at the MSPTS and ETPTS on a weekly basis. These manual water level measurements are then compared to the automated water level data to determine if instrument recalibration is necessary. Instructions for collecting water levels in the treatment cells and collection trench sumps are presented below.

3.3.1.1 Monitoring Water Levels in Treatment Cells

Following are the steps for measuring water levels in the MSPTS and ETPTS treatment cells. These steps do not require entry into the treatment cells.

[1] Open the doors on the treatment cells and allow to ventilate for approximately 5 minutes.

[2] Using a measuring tape or similar calibrated measuring device, measure the water level in each treatment cell. *Always measure from the mark on the middle of the left door on the south side of the cell doors*. Measure to the nearest 0.01 foot (ft) and document the result.

[3] Close and lock the doors on the treatment cells.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[4] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

[5] Compare measured water level to automated water level data for the same time to check for instrument drift. If necessary, recalibrate transducer. See the RFWF for information on instrument calibration.

3.3.1.2 Monitoring Water Levels in Collection Trench Sumps

Following are the steps for measuring water levels in the MSPTS and ETPTS collection trench sumps. These steps do not require entry into the sumps.

MSPTS

The collection trench sump for the MSPTS is located at the approximate midpoint of the groundwater intercept trench, approximately 30 yards west of the system. (This location is also referred to as Mound R1-0 on Figure 1, and represents the location at which system influent samples are collected.) The sump cover can remain in place while the water level is being measured.

Note **The MSPTS sump is located in an area of uneven footing and loose rock, and (as at other areas of the Site) there is a potential for nesting/sunning rattlesnakes at this location; approach it with care.**

[1] Using a measuring tape or similar calibrated measuring device, measure the water level in the collection trench sump. The measuring device should be lowered through the hole in the middle of the sump cover, and the measurement taken from the edge of the hole. Measure to the nearest 0.01 ft and document the result.

Note **DO NOT stand or lean on the cover of the collection trench sump. Doing so can dislodge or damage the cover and create a fall hazard.**

[2] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

[3] Compare measured water level to automated water level data for the same time to check for instrument drift. If necessary, recalibrate transducer. See the RFWF for information on instrument calibration.

ETPTS

The collection trench sump for the ETPTS is located along the road and approximately 100 yards west of the system (ET INFLUENT on Figure 1).

[1] Open the door on the sump and allow to ventilate for approximately 5 minutes.

[2] Using a measuring tape or similar calibrated measuring device, measure the water level in the collection trench sump. *Always measure from the mark on the northern edge of the sump casing*. Measure to the nearest 0.01 ft and document the result.

[3] Close and lock the sump cover.

[4] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

[5] Compare measured water level to automated water level data for the same time to check for instrument drift. If necessary, recalibrate transducer. See the RFWF for information on instrument calibration.

3.3.2 Inspection of Valves and Piping

During normal operations, treatment cells are typically be plumbed so that water flows through them in series. These valve positions are shown in Appendix B. However, it should be noted that series flow may be changed at the ETPTS to parallel flow following the next media replacement activity in 2009; the next version of this document will confirm and clarify valve settings at that system.

A valve key is provided at each treatment system for opening and closing these valves. Valves shall not be "exercised" routinely, as this may cause damage (such as internal scoring due to iron filings within the lines). Instead, valve changes will be made when necessary (i.e., to support media replacement, troubleshooting, or for other specific purposes).

Perform the following steps:

[1] Verify that valves are in the appropriate position for series (or parallel, if appropriate; confirm with management) flow.

[2] Verify that water is flowing through the metering manhole.

[3] Verify that water is flowing out of the effluent piping.

[4] Make sure all doors are closed and that entry of outside air to the system is limited.

[5] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

IF valves are not in the appropriate positions,
THEN immediately inform management. At management’s direction, return valves to desired positions.

IF water is not flowing through metering manhole but water levels within the treatment cells indicate there should be flow,
THEN check for and clear obstructions as described in Section 3.1.3.
IF flow is not restored,
THEN immediately inform management.

IF water is not flowing through effluent pipeline but water levels within the treatment cells indicate there should be flow,
THEN check for and clear obstructions as described in Section 3.3.2.1.
IF flow is not restored,
THEN immediately inform management.

Note **During drought and low-flow periods, water may not be observed in the metering manhole or effluent piping. A lack of flow is normal in this case. After flow resumes, the valve and piping inspection should be performed.**

3.3.2.1 Clearing Effluent Piping

The ETPTS and MSPTS effluent piping discharges to the respective hillsides below the metering manholes. At the MSPTS, the effluent discharge point is below ground in an exfiltration gallery, and is accessed via a cleanout port. At the ETPTS, the effluent discharge point is at the surface. (Discharge from the SPPTS is at an exfiltration gallery, the SPP Discharge Gallery, which is inaccessible. Discharge from the PLFTS is accessible along its entire route, as it does not flow through any lengthy piping. These two systems are not addressed in this section.)

The effluent piping (and/or cleanout port, as applicable) may plug with iron bacteria or debris. This is cleared as described below.

Assemble the following tools and equipment as required:

- Clean water (e.g., distilled or deionized; suitable for disposal to ground);
- Shovel;
- Powered plumber’s snake at least 50 ft long;
- Generator to power snake; and
- Freshly calibrated multigas meter.

Perform the following steps:

ETPTS

[1] Open doors to the metering manhole and allow to vent for a minimum of 5 minutes.

Note **Poor air quality within the metering manholes is common. At the ETPTS, this often includes elevated levels of carbon monoxide. Be sure to confirm air quality is satisfactory before entering or breathing the atmosphere from the manhole.**

[2] Move riprap around the ETPTS effluent piping outfall as necessary to provide clear access to the pipe opening.

[3] Clear any accumulated mud and/or debris from the ETPTS effluent piping outfall.

[4] Reestablish drainage away from the effluent piping outfall as necessary.

[5] Following the operator's manual for the plumber's snake, clear the line between the metering manhole and outfall.

Note **The line may be cleared from the manhole end or the outfall end.**
> If cleared from the outfall end, post a watch at the metering manhole to watch for and keep the plumber's snake from entering the flume and potentially damaging flow meter components.
> If cleared from the manhole end, follow confined space entry requirements.

[6] As the snake is retracted, rinse off and dispose of residue in place.

[7] Make sure all doors are closed and that system is isolated from outside air.

[8] Reconfigure riprap below outfall as necessary to minimize erosion.

[9] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

MSPTS

The MSPTS configuration is slightly different than that of the ETPTS. At the MSPTS, the effluent flows through the metering manhole and then into a small, vertically oriented French drain that has a manhole lid. If infiltration is insufficient in this drain, it then flows to an exfiltration gallery (adjacent to Functional Channel [FC]-4) that is equipped with cleanout ports.

[1] Open doors to the metering manhole and remove lid from the small French drain manhole (located a few feet northeast of the metering manhole). Allow to vent for a minimum of 5 minutes.

Note **Block access to small French drain manhole (using cones, barricades, and so forth) while it is open so no one inadvertently steps into it.**

Note **Poor air quality within the manholes is common. Confirm air quality is satisfactory before breathing the atmosphere from any manhole.**

Note **If entering the metering manhole, confined space entry requirements apply. The French drain manhole is considered too small for entry.**

[2] Remove caps on exfiltration gallery cleanout ports. Following the operator’s manual for the plumber’s snake, gently push the snake through to clear the port across its entire length. If possible, do not power the snake up.

Note **Use care when operating the plumber’s snake. Do not aggressively force it through any line, especially if powered, as this may damage or destroy the PVC pipe.**

[3] Following the operator’s manual for the plumber’s snake, clear the line between the metering manhole and vertical French drain. Due to the short distance, this also may be accomplished without powering the snake. It may be possible to perform this task from ground surface, using a long-poled hook or other tool to guide the end of the snake into the drain opening and through the drain to its opening in the metering or French drain manhole.

[4] Following the operator’s manual for the plumber’s snake, clear the line between the small French drain manhole and the exfiltration gallery. It may be possible to perform this task from ground surface, using a long-poled hook or other tool to guide the end of the snake into the drain opening and along the length of the drain to the T-connection at the exfiltration gallery.

Note **Do not aggressively ram the plumber’s snake against the end of the discharge line (the T-connection at the exfiltration gallery), especially if powered, as this may damage or destroy the PVC construction.**

[5] As the snake is retracted, rinse off and dispose of residue in place.

[6] Flush cleared lines with clean water.

[7] Make sure all doors are closed and French drain and metering manhole lids are properly replaced, and that the system is isolated from outside air.

[8] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.3.3 Routine Media Maintenance

Following are the basic treatment cell maintenance steps. These steps do not require entry into the treatment cells.

ETPTS

[1] Open the access doors and allow the treatment cell to ventilate for a minimum of 5 minutes.

[2] Inspect the condition of the media from above the treatment cell.

[3] Break up crust as required by using a long-handled rake, scaling bar, or equivalent tool. The top layer should also be punctured at least 10 to 15 times with a digging or scaling bar in different locations across the surface of the media (and in continuously differing locations, from visit to visit) to enhance media permeability and release trapped gases that might have accumulated in the media.

Note **Try to get a "feel" for how solidified the media has become and compare this from one visit to the next. This will help gauge the relative amount of precipitates that have formed within the media, which is important because clogging due to precipitates typically drives the need to replace the media.**

[4] If the ZVI surface is too hard to rake or break up, notify management.

[5] After breaking up any iron crust, regrade the media surface with the back of the rake or a similar tool. Be sure that all the media is submerged.

[6] Rinse tools with clean water and discharge the water to the treatment cell. Close the treatment cell doors.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[7] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

MSPTS

[1] Open the access doors and allow the treatment cell to ventilate for a minimum of 5 minutes.

[2] Inspect the condition of the gravel covering the media from above the treatment cell.

[3] Break up crust as required by using a long-handled rake, scaling bar, or equivalent tool. The top layer should also be punctured at least 10 to 15 times with a digging or scaling bar in different locations across the surface of the media (and in continuously differing

locations, from visit to visit) to enhance media permeability and release trapped gases that might have accumulated in the media.

Note **Try to get a "feel" for how solidified the media has become and compare this from one visit to the next. This will help gauge the relative amount of precipitates that have formed within the media, which is important because clogging due to precipitates typically drives the need to replace the media.**

[4] If the ZVI surface is too hard to rake or break up, notify management.

[5] After breaking up any iron crust, regrade the gravel/iron media surface with the back of the rake or a similar tool. Be sure that all the media is submerged.

[6] Rinse tools with clean water and discharge the water to the treatment cell. Close the treatment cell doors.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[7] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

IF the above cannot be performed satisfactorily without entry into the treatment cells,
THEN proceed to Section 3.3.6.

3.3.4 Instrument Vaults

The MSPTS and ETPTS are equipped with concrete vaults through which system flows are routed and various parameters measured. These components were not part of the original design of the systems, but were added in 2006 to enhance maintenance and performance of the systems by allowing closer monitoring and adjustment of fundamental parameters such as flow rates and water levels. A vault containing similar, but simpler, plumbing and metering was installed at the SPPTS in 2008.

During installation of the vaults at the MSPTS and ETPTS, additional plumbing configurations were designed and installed to support potential future needs. The systems were originally designed for downward flow, with groundwater entering at the top of a cell and exiting at the bottom of the cell. Additional plumbing was installed to allow reconfiguration to upflow conditions if this ever becomes necessary or desired. This required the addition of valves and pipes. (Note that the upflow configuration at the MSPTS and SPPTS was tested for several months in late 2007 and found to result in negligible difference in water treatment. However, system maintenance requirements increased sharply due to the need to flush in-line filters up to three times weekly.)

All system flow is routed through the associated instrument vault. For example, at the MSPTS, system influent from the intercept trench first flows through a pipe in the vault, and then to the first cell. Upon exiting that cell, it flows through the vault, and enters the second cell. Upon exiting the second cell, it flows back through the vault before leaving the system. The configuration at the ETPTS is similar. At the SPPTS, only flow from the ITSS into SPIN, and from SPIN into the treatment cells, is routed through the metering vault; a second vault used primarily to house the batteries for the ITSS solar pump system also serves as the access point for effluent sampling, as the discharge line is routed through this lower vault.

Parameters measured at the ETPTS include flow rates (influent, between cells, and effluent), depth to water (intercept trench sump, each of the two cells), line pressures (influent, between cells, and effluent), and cumulative flow volume (influent, between cells, and effluent). Parameters measured at the MSPTS include depth to water (intercept trench sump, each of the two cells), flow rates (influent and effluent), cumulative flow volume (influent and effluent), and line pressure (influent). In addition, battery voltages and radio signal strength are monitored. At the SPPTS, flow rates and cumulative volumes (ITSS and influent), depth to water (SPIN, ITSS), line pressures, and voltages are monitored.

These measurements are collected on a datalogger and automatically transmitted at least daily via a repeater (located on top of the pediment between Ponds A-1 and B-1) to a computer at the Grand Junction office. A software program (Vista DataVision) reads the data and automatically updates data files and graphs that are viewable on the SOARS website (https://soars.lm.doe.gov/).

Table 3 lists the minimum required maintenance for these vaults.

Table 3. MSPTS, ETPTS, and SPPTS Instrument Vault Maintenance Requirements

Activity	Frequency	MSPTS	ETPTS	SPPTS
Check general plumbing and flow maintenance	Daily to monthly[a]	X	X	X
Check data transmission	Weekly	X	X	X
Check and document instrument calibration	As necessary	X	X	X

Notes: [a]Depending on flow configuration and system behavior, more frequent maintenance may be required (such as during upflow conditions, when the filter may need to be flushed every day). Monitor water levels closely to determine whether more frequent maintenance is needed.
Indications of off-normal behavior (i.e., from SOARS website) may require additional maintenance to that described above.

Note

If signs of rodent activity (e.g., nests, droppings, carcasses, or live rodents) are observed within any treatment system enclosures, do not enter the enclosure. Mouse droppings, saliva, and urine carry Hantavirus, which can cause a severe respiratory disease. Contact H&S immediately for instructions on proper handling and disposal.

3.3.4.1 General Plumbing and Flow Maintenance

The vaults at each system should be visited routinely to inspect the general condition of the plumbing and to make other observations. This activity is performed as follows:

[1] Unlock vault door.

[2] Unlock hasps surrounding vault.

[3] Open door and make sure it is locked in place.

Note **Do not enter before confirming door is locked in place. Failure to do so could result in door closing while you are entering or inside vault, potentially causing serious injury.**

[4] Enter vault by climbing down ladder.

[5] Inspect all lines and verify that there are no leaks in any of the plumbing.

[6] Inspect and flush screened cylinders (i.e., filters) as follows:

  a. Turn valves on both sides of influent flow meter piping to “off.”

  b. Remove cylinder that holds the influent screen and check for buildup.

    i. **IF** buildup is observed on screen,
    THEN clear the screen by opening the bottom valve of the screened cylinder on the other pipe and rinsing the screen. Some scrubbing may be required. Dispose of the flushed particulates in place.

    ii. **IF** rinsing and scrubbing is insufficient to clear screen,
    THEN replace screen with a new screen of identical mesh size. New screens should already be located in the vault.

  c. Reattach screen and cylinder and turn both valves on again.

  d. Flush air from cylinder and piping by opening bottom valve of cylinder. Flush until water exits cylinder in a constant stream with no sputtering. Failure to adequately flush the air can result in an air lock, potentially halting flow and requiring a repeat visit.

Note **Stand clear of bottom valve when flushing cylinder to avoid contact with contaminated groundwater.**

[7] Repeat Step 6, flushing between cell screen (ETPTS only) and effluent screen (both MSPTS and ETPTS).

[8] Check all flow meters to make sure they are functioning properly.

  a. If there is no display on the flow meter, push the “display” button on the face of the meter once to see if the meter is still functioning properly. If flow has ceased, the meter display will shut off with the meter still being functional, but should turn back on after pressing the “display” button.

b. If the meter's display does not come on, replace the batteries in the flow meter and check the display again.

c. If the display comes on, but still shows a flow of "0.00," then flow through the meter has ceased or the flow meter turbine is obstructed. Refer to Step 9.

If flow has ceased, follow these steps:

[1] **IF** flow has ceased and water levels in the cells indicate flow should be present, **THEN** ensure Step 6 has been completed, all valves in vault are in the "on" position, and all air has been flushed from the piping.

[2] **IF** flow still does not continue,
THEN turn all valves off again and remove flow meters. Check for blockage in the turbines of the flow meters. This process may involve removing and inspecting the flow meter turbine; refer to the instrument manual for specific instructions. Remove any debris or other material that may be fouling the turbines.

a. Reattach flow meters and turn valves to "on" position, being sure to flush air from the piping by opening the bottom valve of each screened cylinder.

b. **IF** flow does not commence,
THEN contact supervisor for direction.

[3] **IF** flow needs to be adjusted, **THEN**:

a. Adjust inlet ball valve from groundwater intercept trench (i.e., collection sump) to increase or decrease flow as appropriate. Flow increases are limited by available head in the trench; if there is little water in the trench, opening the valve more may not increase flow.

b. Check flow meter to confirm adjustment has had the desired effect.

c. **IF** there is an indication that other valves need to be adjusted, **THEN** consult management first.

[4] Exit vault and close vault door.

[5] Close hasps and lock door.

[6] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.3.5 Changing Between Downflow and Upflow Configuration

Because the ZVI treatment media in the MSPTS and ETPTS (and upcoming spring 2009 addition to the SPPTS) has a limited lifespan, it may become necessary to change the direction of flow through the treatment systems if inadequate treatment of contaminated groundwater is observed. Under normal operations the MSPTS and ETPTS systems are configured such that water enters the top of each treatment cell and exits from the bottom (downflow configuration). In this configuration the effectiveness of the treatment media in the upper portions of the cell decreases over time, as the media becomes oxidized and bound with precipitates (hence the need to break up the media as discussed previously). Under upflow configuration (which will be the norm at the new SPPTS cell) water enters the bottom of each treatment cell and exits from the top. Evaluations of upflow vs. downflow configurations at the MSPTS and ETPTS in late 2007 showed that at those systems, maintenance requirements increases significantly under upflow configuration. This was due to the mobilization of oxidized iron precipitate from the upper portions of the treatment cells. These precipitates accumulated in the filters within the instrumentation vaults to the point that flow was obstructed and the filters had to be checked and rinsed daily.

3.3.5.1 Changing from Downflow to Upflow Configuration

Note **To avoid damaging valves and piping, flow configuration should not be changed in extremely cold temperatures due to increased rigidity of flex hosing and increased brittleness of PVC fittings.**

[1] Unlock vault door.

[2] Unlock hasps surrounding vault.

[3] Open door and make sure it is locked in place.

Note **Do not enter before confirming door is locked in place. Failure to do so could result in door closing while you are entering or inside vault.**

[4] Enter vault by climbing down ladder.

[5] Turn all valves in vault to “off” position.

[6] Detach flex hosing from valve connections in vault walls.

[7] Arrange hosing within the vault such that upflow configuration will be achieved, ensuring that flow direction through flow meter piping is correct for proper flow meter operation. Upflow hose configuration is as follows:

Influent from collection trench → Bottom of Tank 1

Top of Tank 1 → Bottom of Tank 2

Top of Tank 2 → Effluent metering manhole

Note **Each valve on piping coming into or out of the vault should be labeled with its location within the system (e.g., pipe leading to top of Treatment Cell 2 should be labeled TT2).**

[8] Securely attach hosing to correct valve connections.

[9] Verify that hosing configuration achieves upflow conditions and turn all valves in vault to “on” position.

[10] Flush air from piping as described above and ensure that water is flowing through all hoses and piping.

[11] Frequently monitor automated data transmission graphs on the Vista DataVision website to identify rising water levels within the cells, which requires the filters (screened cylinders) be flushed.

Note **It is extremely important to increase inspection frequency following the switch to upflow configuration, if indicated by system performance (i.e., flows and treatment cell water levels). Screened cylinders (filters) must be checked and rinsed daily until clogging decreases, at which point the inspection frequency can decrease to 2 to 3 times weekly.**

[12] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.3.5.2 Changing from Upflow to Downflow Configuration

To switch from upflow to downflow configuration, follow the steps outlined in Section 3.3.5.1, but arrange vault hosing (Step 7) such that downflow configuration is achieved. Proper downflow hose configuration is as follows:

Influent from collection trench → Top of Tank 1
Bottom of Tank 1 → Top of Tank 2
Bottom of Tank 2 → Effluent metering manhole

Note **To avoid damaging valves and piping, flow configuration should not be changed in extremely cold temperatures due to increased rigidity of flex hosing and increased brittleness of PVC fittings.**

3.3.6 Routine Media Maintenance Requiring Treatment Cell Entry

Following are maintenance activities that require entry into the treatment cells, such as breaking up crust in the gravel and iron layers.

Note **If entry into any of the system components is necessary, permit-required confined space entry requirements apply.**

Respiratory hazards may exist in the treatment cells and/or metering manhole (e.g., gases/vapors of hydrogen, hydrogen sulfide, carbon monoxide, ethane, methane, and/or low levels of oxygen). In addition, low concentrations of VOCs are likely present in the water. These hazards shall be addressed prior to entry. Safety personnel may require use of a freshly calibrated photoionization detector, multigas meter, and/or combustible gas indicator for entry.

Assemble the following tools and equipment as required:

- Aluminum or fiberglass extension ladder with an extended length of at least 10 ft;
- Long-handled shovels;
- A pick or Pulaski tool;
- Standard garden cultivator rake, lute, or scaling bar;
- Air compressor and tools for breaking up crust if hand tools are not sufficient; and
- Additional safety equipment required for a confined space entry.

Perform the following steps after securing necessary personnel and permits for confined space entry:

[1] Open the access doors and allow the treatment cell to ventilate for a minimum of 5 minutes.

[2] Confirm air quality is satisfactory for entry, and all other confined space entry requirements have been followed/are in place.

[3] Measure and record depths to the top of the water and top of the media.

[4] Place the ladder into the treatment cell and tie it off securely.

[5] Enter treatment cell.

[6] Rake any gravel overlayer to the side to expose surface of iron media.

[7] Inspect media for formation and accumulation of precipitates and iron crust.

[8] Break up iron crust and disposition as directed by management. (In most cases, the crust will remain in the cell.) The gravel should also be punctured across the entire surface of the cell with a digging or scaling bar to release trapped gases that might have accumulated in the beds.

[9] After breaking up any iron crust, regrade the media surface with the rake or lute.

[10] Redistribute any gravel to form an even layer over the iron media.

[11] Be sure that all the media is submerged.
IF media is not submerged,
THEN notify management immediately.

[12] Exit treatment cell.

[13] Remove the ladder, rinse tools with clean water and discharge the water to the treatment cell. Close the treatment cell doors.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[14] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

[15] If the treatment cells do not drain properly after breaking up the crust, then media replacement is probably required as described in Section 3.3.7. Notify management immediately.

3.3.7 Media Replacement

Media replacement is occasionally necessary. This may be due to consumption of the ZVI, but is more likely a result of oxidation of the ZVI and precipitation of other minerals causing the ZVI to be inaccessible (i.e., insufficient permeability through the media).

Media replacement may be conducted for a portion of the media or the entire media. Both of these activities are routine, but are nontrivial, requiring a significant expenditure of time and effort to plan and complete.

When media replacement (partial or complete) is necessary at the MSPTS or ETPTS (or future SPPTS ZVI cell), determining the amount of media required in advance is crucial. Replacement media currently cannot be obtained locally or on short notice; instead, out-of-state vendors supply the material and may need several weeks or longer to fill an order. **The first step in any media replacement activity must be to calculate the volume of media (gravel and ZVI, separately) that needs to be replaced.**

Basic geometry is used to calculate the volumes of material required, because the cells at these systems are regular forms (cylinders). Several assumptions are made to simplify the calculations:

- Assume that the volume change resulting from mixing ZVI into a given volume of pea gravel is negligible. While not strictly true, the volume increase is too small to warrant a corresponding decrease in the quantities of gravel and ZVI ordered.
- Assume all as-built drawings in Appendix B contain small amounts of error, requiring that final measurements (i.e., prior to installing media, not prior to ordering it) be made of treatment cell internal dimensions.
- Assume that the wall thickness of each vessel at the ETPTS and MSPTS is 1 to 1.5 inches. (Future versions of this document will include details of the SPPTS cell.)
- Assume that each cell will have a 1-ft-thick upper layer of gravel/ZVI over the treatment media, and every cell needs to maintain a minimum depth of 6 inches of groundwater above the top of that layer.

Calculations:

The depth to each layer was based on an estimated depth to water from the lip of the opening for the treatment cell doors.

The volume of each material (gravel, ZVI, or mixture) was estimated by calculating the cross-sectional area of the cell and multiplying by the thickness of the particular layer of interest. The cross-sectional area and the volume are calculated as follows:

$$A = \pi r^2$$

where
A = cross-sectional area (square feet [ft^2])
r = inside radius of vessel (ft)

and

$$V = \pi r^2 h$$

where
V = volume (cubic feet [ft^3])
r = inside radius of vessel (ft)
h = height (thickness) of material (ft)

3.3.7.1 Partial Media Replacement at the MSPTS and ETPTS

Note **If entry into any of the system components is required, permit-required confined space entry requirements apply.**

The steps outlined below may be used for partial media replacement, including replacement of just the gravel/ZVI layer or just the upper portion of the gravel/ZVI layer as needed. Based on the depth of crusting in the media, determine the amount of ZVI and gravel/ZVI mixture that requires replacement. Table 4 lists approximate volumes of gravel/ZVI mixture in the MSPTS and ETPTS treatment cells. (Corresponding figures for the future SPPTS cell will be added in the next version of this document, after that cell has been constructed.) However, it must be stressed that several different versions of the treatment system dimensions have been published, both in previous versions of this manual and elsewhere. Therefore, these figures should be considered working approximations. The volume of ZVI is not provided as it is based on the amount of iron requiring replacement. ZVI specifications are found in Appendix D.

Table 4. Approximate Depth, Thickness, and Volume of MSPTS and ETPTS Treatment Cell Contents

Parameter	ETPTS[a]	MSPTS[b]
Outside diameter (ft)	11.83	9.83
Inside diameter (ft)	11.58	9.67
Inside radius (ft)	5.79	4.83
Cross-sectional area (ft^2)	105.4	73.4
Inside tank height (ft)	12.33	11.58
Depth to water from treatment cell doors (ft)	4.83	4.57
Groundwater head over gravel layer (ft)	0.5	1
Gravel layer thickness (ft)	1	0.5
Depth to top of iron from treatment cell doors (ft)	6.33	6.07
Depth to top of gravel from treatment cell doors (ft)	5.33	5.57
Volume of ZVI/gravel layer (ft^3)	105.4	36.7
Volume of ZVI (ft^3) in ZVI/gravel mixture	10.54	4.08
Volume of ZVI layer (ft^3)	588.4	367.7
Drainage layer thickness (inches)	11	12

[a]Based on calculations provided by the closure contractor; not confirmed since Site closure.
[b]Based on engineering drawings.
Note: Top gravel layer is a mix of gravel and ZVI, but for convenience is often referred to simply as a gravel layer.

Follow requirements for permit-required confined space entry for any entry into the treatment cells, sump, or metering manhole. Respiratory hazards may exist in the treatment cells and/or metering manhole (e.g., hydrogen gas, hydrogen sulfide, carbon monoxide, ethane, methane, and/or low levels of oxygen). In addition, low concentrations of VOCs are likely in the water. These hazards shall be addressed prior to entry. Safety personnel may require use of a freshly calibrated photoionization detector, multigas meter, and/or combustible gas indicator for entry. Similarly, airborne particulates from the ZVI and pea gravel may be hazardous; ensure full involvement by H&S personnel and follow all associated requirements.

Assemble the following tools, materials, and equipment as appropriate and necessary for the condition and estimated volume of ZVI to be removed:

- Erosion control materials such as straw wattles or silt fence;
- Aluminum or fiberglass extension ladder with an extended length of at least 10 ft;
- Shovels;
- Logbook;
- Standard garden cultivator rake or equivalent;
- Pry bars, breaker bars, or other manual tools for breaking up crust;
- Air compressor, chippers or air hammers, and/or other tools for breaking up crust;
- Backhoe with a hoe ram attachment;
- Vacuum truck or equivalent to remove loose media;
- Dump truck or other means of containment and transport for spent material;
- Sturdy tarp(s) or sheet plastic;
- Plywood sufficient in size to cover tarp(s)/sheet plastic;
- Pea gravel;
- Replacement, fresh ZVI (as required);
- Pump capable of draining treatment cell along with necessary hoses and storage tanks (if needed); and
- Portable generator (if needed).

Perform the following steps:

[1] Establish erosion controls downgradient of the area that will be disturbed by the construction activities.

[2] Prior to entry, open the access doors on each treatment cell and allow treatment cells to ventilate for a minimum 5 minutes before entry. Handrails, doors, and frames may be removed to allow better access. The treatment cell tops can also be removed if desired for easier access to media.

[3] **IF** removed media is not immediately placed into a waste container,
THEN set up a staging area for the spent ZVI and gravel. Create a bermed area capable of holding the volume of material planned to be removed, cover it with tarp/sheet plastic, and place plywood boards or the equivalent on top of the polyethylene tarp to hold it down and minimize damage from the removed materials.

Note **In case of high winds, do not leave this prepared tarp/board surface unloaded (i.e., without the added weight of ample ZVI/gravel to hold it in place) for any length of time; prepare it when it is needed and put it to use immediately.**

[4] Measure and record the depth to the top of the water and to the top of the gravel/media. Note: The level of the media and the water level might not be the same after media replacement. The final level is based on the height of the interior pipes and maintaining sufficient water over the top of the gravel/iron mixture as described in Table 4 and Figure 2.

[5] Close the valve(s) on the influent line to the system. (Groundwater will continue to collect in the collection trench, but will not enter the system.)

[6] Remove water from the cells by placing a pump or pump intake into a treatment cell (into a depression if possible). Place pump discharge line into the collection trench sump, or into a storage tank. Remove as much water as possible to expose media. Remove pump and/or intake line. Alternatively, the pump intake may be connected to the cell's effluent line if appropriate (e.g., if media permeability is sufficient and pump rate is low enough to pose minimal stress on the plumbing and other components of the system, and if fittings are compatible).

[7] After media is exposed, remove as much loose material as possible with a suction line from a vacuum truck or a backhoe.

[8] Break up hardened material either using the backhoe with hoe ram attachment or hand-held equipment. Repeat media removal steps as needed to remove all of the identified material out of each treatment cell. Continue water removal as necessary.

IF using a backhoe,
THEN break up the material in the center of the treatment cell, staying 6 to 12 inches away from the vessel wall. Remove as much media as possible in this manner.

IF using hand-held equipment,
THEN place the ladder in the treatment cell and tie it off securely. Use air hammers with chisel attachments (or equivalent) to carefully remove material adjacent to and adhering to the wall of the treatment cell, and loosen other material as necessary.

Note **The treatment cells are made of high-density polyethylene (HDPE), and are therefore fragile. Use caution when working near the walls. All damage must be repaired prior to media replacement.**

[9] Removed iron and gravel shall be placed in appropriate waste containers or a staging area. This material shall be managed and disposed of as directed by Environmental Compliance personnel.

Note **If replacement iron appears oxidized (rusted or clumped), do not use.**

[10] After the material is removed, add ZVI until it reaches the height specified in Table 4. Vent pipes should be reinstalled or replaced (see Figure 2 for conceptual design, and Figure 3 for a generalized as-built from the ETPTS prior to Site closure).

[11] Verify that the height of the ZVI is at the specified depth below the doors on the vessel (Table 4).

Note **The height of the ZVI shall not be more than 1.5 ft below the bottom of the influent (in downflow configuration; i.e., the upper pipe) opening to the vessel, regardless of the volume of iron added to the treatment cell or as listed in Table 4.**

[12] Once the iron has been added (if any), the surface shall be raked level.

[13] Add a mixture of 10 percent ZVI and 90 percent pea gravel by volume as per Table 4. The gravel/iron shall be completely mixed in a concrete mixer or similar mixing device. The resulting volume will likely be very similar to the volume of pea gravel because the finer-grained iron will fill the void space in the pea gravel. The top of this layer shall not be higher than 10 inches below the bottom of the upper influent/effluent opening. Do not overfill the treatment cell. Vent piping and distribution piping should be reinstalled or replaced as shown on Figure 3.

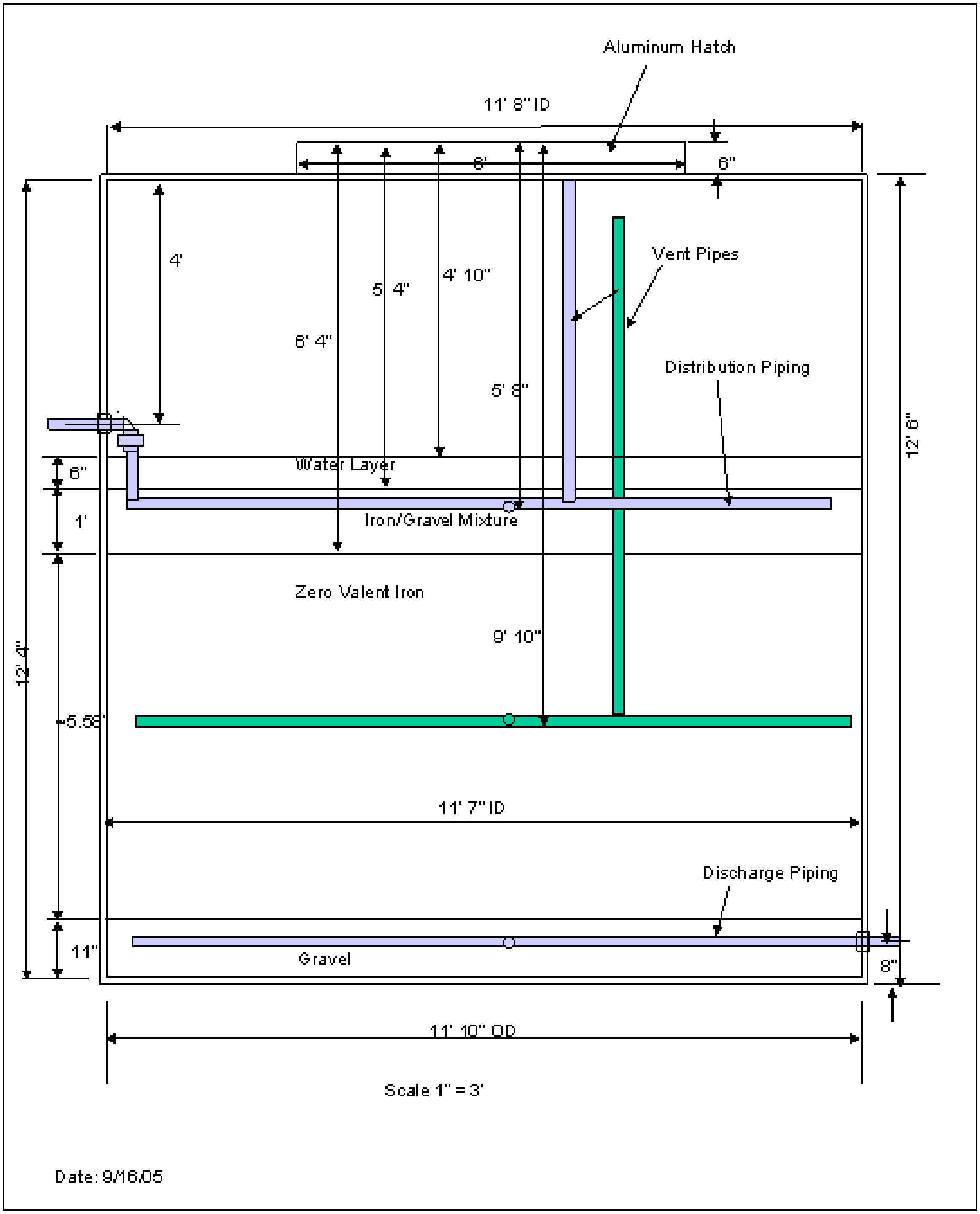
[14] Rake the top of the gravel/iron mixture to level it.

[15] Once all work on the treatment cell is complete, remove the ladder and replace the cell top, railings, and doors if previously removed.

[16] Configure the valves to ensure that the treatment cells will operate in series (or as otherwise desired).

[17] Open the valve on the system influent line (from the collection trench). If sufficient water is not available from that source to quickly submerge the media, add sufficient clean water to accomplish this. Insert a board or other flat surface if necessary to prevent inflow from disrupting the flat surface of the media/gravel. Allow the vessel to fill. Check the water level against historic levels. If a storage tank was used to contain water pumped from the cells, this water should be returned to the top of the first cell or to the collection trench sump.

[18] **IF** the gravel/iron mixture is not submerged below the water at the depth in Table 4, **THEN** quickly determine whether this is due to slow filling, or excessive material in the gravel/iron layer.



Notes: ETPTS media was completely replaced in September 2005, generally corresponding to the date of this drawing. It is not known how accurate this diagram is, nor whether it represents conditions before or after media replacement.
Subsequent to the date of this drawing, the system was revised (during installation of the instrument vault) to allow upflow configuration. Therefore, what is shown as "Discharge Piping" and "Distribution Piping"—denoting a downflow configuration—can now be reversed to allow upflow.

Figure 3. Cross-Section of ETPTS Treatment Cell Prior to Site Closure

[19] **IF** the incomplete submergence is due to slow filling,
THEN add clean water as necessary to achieve full submergence of the top layer, and monitor cell conditions continuously for several hours; perform this level of monitoring at least twice daily for the next several days, reducing as appropriate for the next few weeks to confirm the water level remains above the top of this layer. Emergence of any portion of this top layer at any time will require material removal, as described in step 20. Failure to remove this material could result in early failure of the ZVI, so this step is critical.

[20] **IF** the incomplete submergence is due to excessive material in the top layer,
THEN immediately remove excess material to achieve full submergence of the top (gravel/ZVI) layer.

Note **No portion of the gravel/iron mixture shall extend above the water surface at any time.**

[21] Remove the board (if used) and the ladder from the treatment cell.

[22] Rinse tools with clean water and discharge the rinse water to the treatment cell. Close the treatment cell doors.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[23] Polyethylene tarps, personal protective equipment (PPE), and other materials shall be managed and disposed as directed by Environmental Compliance staff (most likely as sanitary waste).

[24] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.3.7.2 Total Media Replacement at the MSPTS and ETPTS

Note **If entry into any of the system components is required, permit-required confined space entry requirements apply.**

The following steps describe complete replacement of the ZVI-based media in one or both cells of a system. (See Appendix E for photographs of previous media replacement activities.) However, this procedure can also be used for partial replacement, including replacement of only the gravel/iron layer or just the upper portion of the gravel/iron layer as needed.

Table 4 shows the approximate volumes of ZVI and gravel/ZVI mixture in the treatment cells. These calculations are explained in Section 3.3.7.1. Specifications for the ZVI are provided in Appendix D.

Follow requirements for permit-required confined space entry for any entry into the treatment cells, sump, or metering manhole. Respiratory hazards may exist in these locations (e.g., hydrogen gas, hydrogen sulfide, carbon monoxide, ethane, methane, and/or low levels of oxygen). In addition, low concentrations of VOCs are likely in the water. These hazards shall be addressed prior to entry. Safety personnel may require use of a freshly calibrated photoionization detector, multigas meter, and/or combustible gas indicator for entry. Similarly, airborne particulates from the ZVI and pea gravel may be hazardous; ensure full involvement by H&S personnel and follow all associated requirements.

Assemble the following tools, materials, and equipment:

- Erosion control materials such as straw wattles or silt fence;
- Aluminum or fiberglass extension ladder with an extended length of at least 10 ft;
- Shovels;
- Logbook;
- Standard garden cultivator rake or equivalent;
- Pry bars, breaker bars, or other manual tools for breaking up crust;
- Air compressor, chippers or air hammers, and/or other tools for breaking up crust;
- Backhoe with a hoe ram attachment (as needed);
- Vacuum truck or equivalent to remove loose media (optional);
- Tarp(s) or sheet plastic;
- Plywood sufficient in size to cover tarp(s)/sheet plastic;
- Pea gravel (3/8 inch);
- Appropriate quantity and type(s) of ZVI;
- Pump capable of draining treatment cell along with necessary hoses;
- Dump truck or other means of containment and transport for spent material;
- Filter fabric;
- Plumber’s snake (at least 50 ft long);
- Portable generator (if needed);
- All equipment required for a permit required confined space entry;
- PVC pipes, joints, couplers, elbows, slotted pipe, caps, plugs, and so forth as necessary to replace internal plumbing components;
- Liquid bleach (5.25% sodium hypochlorite solution);
- Water storage tank;
- Paper towels and brushes; and
- Sprayer.

Perform the following steps:

[1] Establish erosion controls downgradient of the area that will be disturbed by the construction activities.

[2] Prior to entry, open the access doors on each treatment cell and allow treatment cells to ventilate for a minimum of 5 minutes. Guardrails, doors, and frames may be removed to allow better access to the treatment cell; for best access, remove cell tops.

[3] **IF** the removed media will not be immediately placed into a waste container,
THEN set up a staging area for the spent ZVI and gravel. Create a bermed area capable of holding the volume of material planned to be removed, cover it with tarp/sheet plastic, and place plywood boards or the equivalent on top of the polyethylene tarp to hold it down and minimize damage from the removed materials.

Note **In case of high winds, do not leave this prepared tarp/board surface unloaded (i.e., without the added weight of ample ZVI/gravel to hold it in place) for any length of time; prepare it when it is needed and put it to use immediately.**

[4] Measure and record the depth to the top of the water and to the top of the gravel/media. Note: The level of the media and the water level might not be the same after media replacement. The final level is based on the height of the interior pipes and maintaining sufficient water over the top of the gravel/iron mixture as described in Table 4 and Figure 2.

[5] Close the valve(s) on the influent line to the system. (Groundwater will continue to collect in the collection trench, but will not enter the system.)

[6] Remove water by placing a pump or pump intake into the treatment cell (into a depression if possible). Place pump discharge line into the collection trench sump, or into a storage tank. Remove as much water as possible to expose media. Remove pump and/or intake line. Alternatively, the pump intake may be tied into the cell's effluent line if appropriate (e.g., if media permeability is sufficient and the pump rate is low enough to pose minimal stress on the plumbing and other components of the system, and if fittings are compatible).

[7] After media is exposed, remove as much loose material as possible with a suction line from a vacuum truck or a backhoe.

[8] Break up hardened material either using the backhoe with hoe ram attachment or hand-held equipment. Repeat media removal steps as needed to remove all of the planned material from each treatment cell. Continue water removal as necessary.

IF using a backhoe,
THEN break up the material in the center of the treatment cell, staying 6 to 12 inches away from the vessel wall. Remove as much media as possible in this manner.

IF using hand-held equipment,
THEN place the ladder in the treatment cell and tie it off securely. Use air hammers with chisel attachments (or equivalent) to carefully remove material adjacent to and adhering to wall of treatment cell, and loosen other material as necessary.

Note **The MSPTS and ETPTS treatment cells are made of HDPE, and are therefore fragile. Use caution when working near the walls. All damage must be repaired prior to media replacement.**

[9] Remove remaining iron along with gravel at the bottom of the treatment cell. Place removed materials in a waste container or in the staging area. This material shall be managed and disposed as directed by Environmental Compliance personnel.

Note **There is PVC pipe at the bottom of each treatment cell. Do not use excessive force when loosening iron at the bottom of the cell to avoid breaking these pipes. All broken pipes must be repaired or replaced prior to media replacement.**

[10] Measure the height of the treatment cell and the height from the bottom of the cell to the inlet piping.

[11] Check the lines entering and exiting the treatment cells. If there is evidence of plugging, the lines to both treatment cells shall be cleaned. Because of the presence of the instrumentation vault and its many associated plumbing components, using a plumber's snake for this activity may not be appropriate. The subcontracted construction support should be consulted to determine whether a snake may damage this plumbing, and if so, alternatives to using a snake shall be explored. Potential alternatives include replacing obstructed lines or running an appropriate quantity and concentration of acid through the obstructed lines (while incorporating all necessary safety precautions, and properly managing and disposing of used acid).

[12] If biological growth ("slime") is present, disinfect the influent line by pushing a cloth with chlorinated solution along the inside of the pipe or by similar means. The chlorinated solution consists of approximately ¼ cup household bleach (e.g., Clorox) in 1.5 gallons of water. Make sure the cloth is sturdy enough for this use, and is firmly affixed to the tool used to push it, as it must be completely and entirely (i.e., all pieces) removed from the line before the system is returned to operation.

[13] If biological growth ("slime") is present, disinfect the lines between the cells by sealing the end with a threaded plug and filling the line with chlorine solution prepared as above. (The same solution may be reused if desired and appropriate.) Allow the chlorinated solution to remain for 12 hours and then drain. Rinse with water. Collect chlorinated water and rinsate. This solution may be used for spraying the sidewalls of the tank.

[14] If biological growth ("slime") is present, disinfect the inside of the tank by spraying the tank walls and bottom with chlorinated solution prepared as above. (The same solution may be reused if desired.) Place the distribution/collection piping in the bottom of the tank and cover with chlorinated solution. Let sit for 12 hours and then remove excess water and wipe or rinse off distribution piping, walls, and tank bottom. Collect chlorinated water and rinsate, if any, for proper management and disposition.

Note **Air with elevated concentrations of chlorine gas is hazardous. The risk is greatest when disinfecting tank insides, but may also be of concern when disinfecting the lines. Personnel shall consult the dedicated safety professional for appropriate controls and shall implement those controls as directed.**

[15] After disinfection is complete, inspect or replace distribution/collection piping a the bottom of the cell.

[16] Add bottom gravel drainage layer as listed in Table 4. Rake this layer so that it is level and covers the distribution/collection piping at the bottom of the cell. If the treatment cells will be filled with -8 +50 iron, cut new filter fabric and place it over the gravel layer.

Note **If replacement iron appears oxidized (rusted or clumping), do not use.**

[17] Add iron to the heights listed in Table 4. Carefully add the first few feet of iron to avoid disrupting the gravel layer. Vent/piezometer piping should be reinstalled or replaced as shown on Figure 3. Rake the iron surface level.

[18] Add a mixture of 10 percent iron and 90 percent pea gravel by volume up to the height indicated in Table 4. The gravel/iron shall be completely mixed in a concrete mixer or similar mixing device, and should be placed into the cell in lifts with each lift spread evenly across the media surface before adding the next lift. This will help keep the gravel and iron mixed as it is placed. The resulting total volume will be similar to the volume of pea gravel because the iron will fill void spaces in the pea gravel. Upper distribution/collection piping shall be reinstalled or replaced as shown on Figure 4.

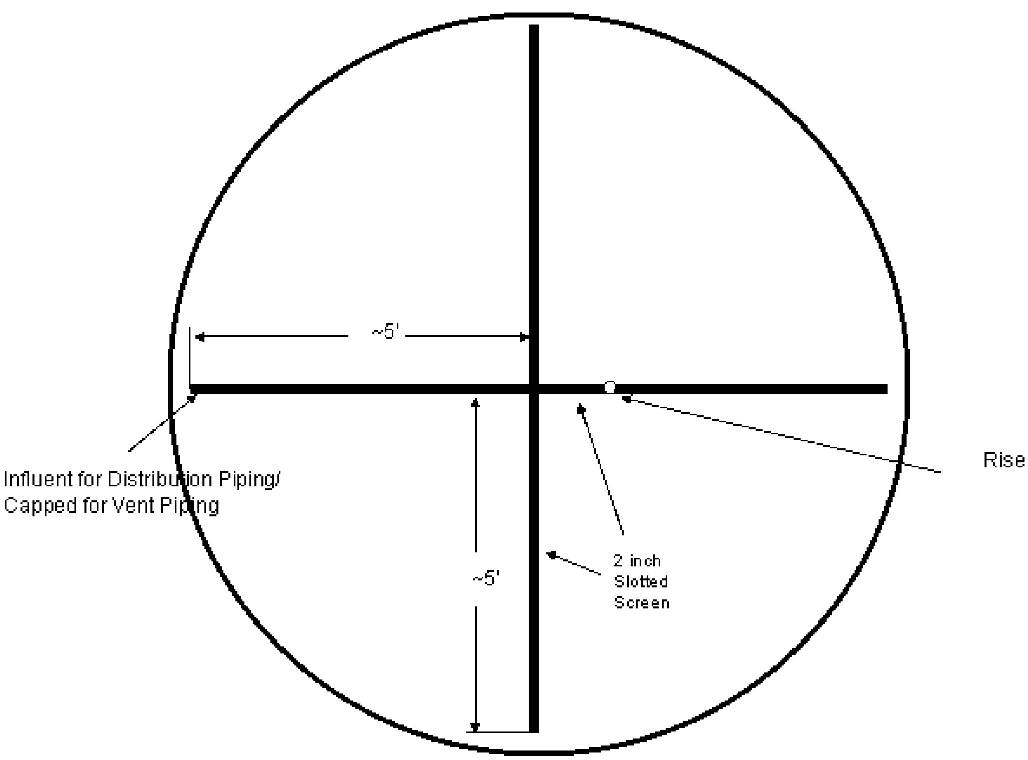


Figure 4. Vent, Distribution, and Discharge Piping Layout

[19] Do not overfill treatment cell. The top of the media must remain below the water level in the cell at all times. Rake the top of the gravel/iron mixture to level it.

[20] Once all work on the treatment cell is complete, remove the ladder and replace the top, railings, and doors if previously removed.

[21] Configure the valves to operate the treatment cells in series (or as otherwise desired).

[22] Open the valve on the system influent line (from the collection trench). If sufficient water is not available from that source to quickly submerge the media, add clean water to accomplish this. Insert a board or other flat surface if necessary to prevent inflow from disrupting the flat surface of the media/gravel. Allow the vessel to fill. Check the water level against historic levels. If a storage tank was used to contain water pumped from the cells, this water should be returned to the top of the first cell or to the collection trench sump.

[23] **IF** the gravel/iron mixture is not submerged below the water at the depth in Table 4,
THEN quickly determine whether this is due to slow filling, or excessive material in the gravel/iron layer.

[24] **IF** the incomplete submergence is due to slow filling,
THEN add clean water as necessary to achieve full submergence of the top layer, and monitor cell conditions continuously for several hours; perform this level of monitoring at least twice daily for the next several days, reducing as appropriate for the next few weeks to confirm the water level remains above the top of this layer. If necessary due to lack of available groundwater, close the influent valve from the collection sump and the effluent valves on each cell, fill the cells with sufficient water to cover the media surface as described above, and monitor water levels in the collection sump until there is sufficient groundwater available to maintain coverage over the media, at which time these valves may be reopened and groundwater flow may be initiated through the cells. Emergence of any portion of the top layer of media at any time will require material removal, as described in the step 24. Failure to remove this material could result in early failure of the ZVI, so this step is critical.

[25] **IF** the incomplete submergence is due to excessive material in the top layer,
THEN immediately remove excess material to achieve full submergence of the top (gravel/ZVI) layer.

Note **No portion of the gravel/iron mixture shall extend above the water surface at any time.**

[26] Remove the board (if used) and the ladder from the treatment cell.

[27] Rinse tools with clean water and discharge the rinse water to the treatment cell. Close the treatment cell doors.

Note **It is very important to limit the amount of air entering the system, because the addition of fresh air can contribute to oxidation of the ZVI media. Although the cell doors are not airtight, proper closure can help limit oxygen in the cells. Therefore, after completion of maintenance, make sure cell doors are completely closed and that the system is isolated from outside air. The doors overlap. Close the door with the overlap on the bottom edge first, before closing the second door. There should not be a gap.**

[28] Polyethylene tarps, PPE, and other materials shall be dispositioned as sanitary waste unless otherwise directed by Environmental Compliance staff.

[29] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.4 SPPTS

Unlike the MSPTS and ETPTS, which are gravity-fed systems, the SPPTS utilizes two energized pumps to deliver water to the treatment cells. The SPPTS treatment cells are buried ~14ft below grade, precluding the easy access afforded by the MSPTS and ETPTS. (Gas vents installed within each cell at influent and effluent locations afford limited access [e.g., for in-cell water level checks or sampling] to the cells. Also, a new ZVI-containing cell, more similar to those at the MSPTS and ETPTS but for the treatment of uranium, will be installed in early 2009, but is not addressed here; it will be included in the next revision to this document.) The treatment cells are situated between the upgradient collection trench and the downgradient remnants of the ITS (of which there are also remnants upgradient of these cells).

Water is collected by the upgradient portion of the ITS and is routed to the groundwater collection trench, where this water and other local groundwater collects in a sump (SPIN) at the deepest part of the trench. SPIN is equipped with a solar-powered pump the transfers the collected water into the treatment cells.

Downgradient, the ITS remnants include the terminal points of the main east and west perforated PVC collection manifold (ITSE and ITSW, respectively) and portions of the perforated laterals that feed into these manifolds. The manifolds now route collected groundwater into the ITSS (the result of the “Phase I” upgrades to the SPPTS, completed in October 2008). The ITSS is a collection sump with a perforated lower section that is seated in gravel backfill so that other local groundwater, particularly any that may be migrating through the ITS gravel and sand wraps, collects and flows into the sump. A second solar-powered pump is installed within ITSS, and accumulated water is pumped up the hill and directly into SPIN. Therefore, the pump in SPIN transfers water from the collection trench as well as the ITSS into the treatment cells.

Discharge from the treatment cells is routed through a flume located in a manhole (former effluent sampling location SPPMM01), through the battery vault (in which effluent sampling location SPOUT is located) for the ITSS pump system, and into a subsurface discharge gallery (SPPDISCHARGEGALLERY, often informally referred to as the DG) located east of the ITSS solar array.

Routine inspections are required to ensure proper system operation. This includes checking pump operation, visually inspecting the solar panels and operating systems, checking the automated data transmission to monitor flow rates and battery voltages, and checking water levels. Procedures for routine inspections and maintenance are listed in the following sections.

IF the SPPTS pumps are moved or disturbed,
THEN the pumps need to be set so that they maintain water levels within the range given in Table 5.

Table 5. Normal Groundwater Depths and Elevations in SPIN (SPPTS Collection Sump) and PZ 71099

Location	Depth to Water (ft)	Water Elevation
Piezometer 71099	Deeper than 21	Below 5,880 ft
Collection sump/SPIN[a]	27−30	5,871 ft−5,874 ft
Intercept Trench Sump (ITSS)[b]	12−14	5,862 ft−5,864 ft

[a]Measured from top of housing (elevation=5,,901.44 ft)
[b]Measured from top of pump casing (elevation=5876.54)

Note **After heavy precipitation events, the water levels in the groundwater intercept trench (as determined in SPIN) and corresponding influent/effluent flow rates may be higher than normal, but should return to the normal range within a few days.**

3.4.1 Routine Inspections and Maintenance of SPIN Pump System

SPIN is the collection sump from which water is pumped through the instrumentation vault and into the adjacent treatment cells. The collection trench and the ITSS both contribute water to SPIN.

Note **If signs of rodent activity (e.g., nests, droppings, carcasses, or live rodents) are observed within any treatment system enclosures, do not enter the enclosure. Mouse droppings, saliva, and urine carry Hantavirus, which can cause a severe respiratory disease. Contact H&S immediately for instructions on proper handling and disposal.**

3.4.1.1 Monitoring Water Levels in SPIN

Water levels in SPIN are monitored remotely by checking the automated data transmission. Manual water level measurements may be required to troubleshoot problems with the SPIN pump or the automated data. Water levels may also be measured in nearby piezometer (PZ) 71099 (i.e., pre-closure “influent” sampling location SPPMM02) if desired (or other PZs within the trench; water levels in nearby wells may also aid in the evaluation). Table 5 lists typical water elevations and depth to water in both of these locations. The pump in SPIN does not operate continuously; rather it operates on pre-set cycles, resulting in an oscillating water level that is visible on the automated data transmission graphs.

Manually Monitoring Water Levels in SPIN

[1] Remove both the outer and inner lids of SPIN and, if necessary, carefully move the pump wires located in the top of the casing.

[2] Using a measuring tape or similar calibrated measuring device, measure the water level in each treatment cell. *Always measure from the mark on the eastern edge of the casing rim*. Measure to the nearest 0.01 ft and document the result.

[3] Carefully and neatly place all wires back into the top of the casing, and replace both the inner and outer lid.

IF manual water level measurements differ significantly from automated data output,
THEN water level transducer in SPIN should be recalibrated. See the RFWF for instructions.

IF the automated data show a constant depth to water in SPIN that is less than 27 ft below the top of housing, and those data are confirmed to be accurate,
THEN the pump has malfunctioned. Refer to Section 3.4.1.4 for information on troubleshooting the pump.

IF the pump is operating (Section 3.4.1.3) yet water levels in SPIN are continuously rising,
THEN the sump may need to be redeveloped. Notify management immediately. Refer to Section 3.4.1.5.

IF water levels within the collection trench (as determined in SPIN, and augmented with data from any or all trench PZs—70799, 70899, 70999, 71099) remain elevated for more than 2 consecutive months after a precipitation event,
THEN notify management.

3.4.1.2 Plumbing and Flow Maintenance at SPIN Instrumentation Vault

The vault at SPIN should be visited routinely to inspect the general condition of the plumbing and to make other observations. This activity is performed as follows:

[1] Unlock vault door.

[2] Unlock hasps surrounding vault.

[3] Open door and make sure it is locked in place.

Note **Do not enter before confirming door is locked in place. Failure to do so could result in door closing while you are entering or inside vault.**

[4] Enter vault by climbing down ladder.

[5] Inspect all lines and verify that there are no leaks in any of the plumbing.

[6] Inspect screened cylinders (i.e., filters) for buildup of debris.

IF buildup is observed on screen,
THEN follow these steps to clean the filter:

a. Turn off the pump associated with the screen needing to be cleared

   i. For SPIN, turn the switch on the bottom of the silver pump controller to the “OFF” position

   ii. For ITSS, push the ON/OFF button on the black pump controller. The light on the button should turn red.

b. Close the brass ball valves on either end of the piping. The SPIN line is equipped with two valves, while the ITSS piping is only equipped with one valve, located on the downstream end of the pipe.

Note **DO NOT close the brass valves before turning off the associated pump! This can result in pipe rupture (requiring costly repairs to the system) and other problems if the pump energizes.**

c. Remove cylinder that holds the blocked screen, and flush the screen with clean (tap, distilled, or deionized) water. Dispose of the flushed particulates in place.

d. Reattach screen and cylinder and turn brass valves on again. Make sure the red valve on the bottom of the cylinder is in the “OFF” position.

e. Turn the pump back on. SPIN should immediately start pumping, while ITSS will likely not pump immediately due to the timer installed in that system.

Note **DO NOT turn the pump back on before restoring the brass valves to the “ON” position! This can result in pipe rupture (requiring costly repairs to the system) and other problems if the pump energizes.**

[7] Check both flow meters to make sure the displays are on.

[8] Exit vault and close vault door.

[9] Close hasps and lock door.

[10] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.4.1.3 Checking the SPIN Solar Panel, Charging System, and Batteries

<u>On a monthly basis</u>, inspect the following on the electrical system:

[1] Check for loose or damaged wires, including checking the insulation on the wires. Animals often chew through insulation and wires.

[2] Make sure all equipment is securely mounted. High winds as well as temperature fluctuations can loosen mounting hardware.

[3] The green light on the pump controller (ME 24/48) should be on. The red light for the treatment cell should not be on.

On a monthly basis, inspect the following on the solar panels:

[1] The panels should be facing south and tilted at a pitch angle of approximately 40 degrees.

[2] Remove any equipment and vegetation that may be blocking the panel. Do not scratch the glass, and use care as the panels can get very hot through exposure to the sun.

[3] The surface of the solar panels should be clean. Light dust on the surface is acceptable, but no other soiling, including bird droppings. Do not scratch the glass, and use care as the panels can get very hot through exposure to the sun. (Note: The panels are in a fixed position and should not be moved during routine activities, including cleaning.)

IF the panels are more than dusty,
THEN rinse with clean water (i.e., tap, distilled, or deionized).

IF dirt is difficult to remove,
THEN wash with a wet paper towel or a wet soft cloth.

The batteries (as of January 2008) are Concorde Sun Xtender® batteries, Model PVX-2120L. These deep-cycling batteries are made specifically for backup power for photovoltaic systems. Each 12-volt battery is sealed and "maintenance-free." Should replacement of the battery bank become necessary, comparable batteries shall be used. Additional information on the batteries is presented in the RFWF. The lid to the battery box should remain closed at all times except during inspection and repair. The batteries need to be inspected monthly for signs of corrosion and overcharging. These signs include the following:

- Is there corrosion at the terminals?
- Do the wires appear to be damaged or oxidized?
- Are the batteries bubbling?
- Is there moisture accumulation on the top of the batteries?
- Are the batteries bulging?
- Is the battery operating at full capacity?

IF there is evidence of damage or overcharging the batteries,
THEN contact management immediately. It may be necessary to contract an electrician to determine if repairs are necessary.

On a monthly basis, check the following on the Morningstar Prostar 30 load controller. This controls the load on the batteries applied by the pump. Refer to the charge controller manual in The RFWF. for further information and the location of status lights.

[1] If there is sunlight, make sure that the charging light emitting diode (LED) is green. If it is nighttime, this light should be off.

[2] Check the battery status LEDs. Under normal operation, the red LED to the right should not be illuminated. If it is blinking the batteries are low, which should only be true during morning hours. If it is blinking after mid-day or is steadily on, these are both indications that the battery is not being charged and an electrician should be consulted; notify

management immediately. The green and yellow lights mean that the battery is charged or is partially charged.

[3] The battery type selector should be set to the type of batteries in use. At this time, these are sealed batteries (Concorde PVX-2120L). If not set at the appropriate battery type, using a small screwdriver, turn the selector to the appropriate battery type and count the number of flashes on the battery status lights. The number of flashes should match the battery type as stated in the manual. For example, there should be two flashes for sealed batteries.

[4] Check the digital display.
IF any of the following are displayed,
THEN notify management immediately, as it will be necessary to contract an electrician for repairs:

LVD—low voltage disconnect

HVD—high voltage disconnect

Hot—high temperature disconnect

OCP—overcurrent and short circuit protection

[5] There are three readings on the digital display. If the following are not as stated, check the manual in the RFWF to correct:

a. The battery status should read approximately 25 to 29 volts.

b. The load amp reading will likely be 0.0 because the pump is not constantly in operation, rather it cycles on periodically. In case the pump is on at the time of inspection, continue to observe this reading for several minutes before making adjustments. It may also be necessary to inspect SPIN and try to hear the pump, but because it operates so quietly this may be difficult; it may be necessary to remove the covers from the top of SPIN and listen more closely and/or measure the water level to determine whether the pump is operating.

c. The solar amp should read zero, since the Xantrex charge controller receives the current from the solar array.

[6] Make sure that the system has not been disconnected from the load. The button in the upper right-hand corner of the charge controller should not be lit up.

[7] Perform the diagnostic test as described in Section 5.4 of the Prostar 30 product manual in the RFWF by pressing the load disconnect switch for at least 4 seconds. After the diagnostic test is complete, make sure that neither the solar array nor the load is disconnected (the light in the upper right-hand corner of the charge controller should be off and the display should read out the solar amps and load amps). If any adjustments or repairs are necessary, notify management immediately as it will be necessary to contract an electrician.

[8] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

On a weekly basis, perform the following on the Xantrex charge controller:

[1] Check that there are no active faults or warnings. If a fault or warning is active, the default display will indicate this condition.

[2] From the output display screen (default screen if no warnings/faults are active), check that the output voltage (battery voltage) is between 25 and 29 volts. This reading should closely match the "Batt Volts" reading from the Morningstar charge controller.

[3] Press the down button and check that the input amps (solar amps) do not read zero.

[4] From the input display screen, press the down button twice more to check the charging status. The status should read "Bulk," "Absorb," or "Float."

[5] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

Twice a year, typically in January and July to cover diverse conditions, perform the following in addition to the above:

[1] Measure the current on the solar array with an ammeter and make sure it does not exceed 30 amps.

[2] Check that the controller functions and LED indicators are correct for the system conditions.

[3] Check the voltage on the batteries with a voltmeter. These should each read approximately 12 to 14 volts.

IF any of the conditions are not met,
THEN notify management immediately, as it will be necessary to contract an electrician to determine if repairs are necessary.

3.4.1.4 Troubleshooting the SPIN pump system

If the pump ceases operation (as indicated by a constant depth to water in SPIN and a constantly zero flow rate), follow the instructions below.

[1] Ensure the SPIN filter in the instrumentation vault is clear.

IF filter is clogged
THEN follow instructions in section 3.4.1.2 to clear filter

[2] Ensure the brass valve on the SPIN line in the instrumentation vault are in the "ON" position.

[3] Ensure the quick connect wire connections in the top of the SPIN pump casing are secure.

[4] Ensure the solar panels, charging system, and batteries are operating properly (Section 3.4.1.3).

[5] Ensure both the switch on the bottom of the pump controller and the red switch for the solar system are in the “ON” position.

IF problem persists and pump will not operate
THEN notify management

3.4.1.5 SPPTS Sump (SPIN) Redevelopment

The screen on the sump installed in the collection trench may plug due to a buildup of fine material. If water levels rise in the collection trench and the pump is functioning properly but water levels do not fall, then the sump may be clogged and may need to be evaluated to determine if redevelopment is necessary.

A water well drilling company should be used for sump redevelopment. Several methods may be used to perform this work; the method selected shall be at the discretion of the water well drilling company. In the past, a surge block has been utilized and successfully restored operation to the system. An advantage of this method is that fines are removed in this process. A step-by-step procedure is not listed here because the methodology varies according to the specific techniques and equipment employed, and the company performing the work. With time, the need for redevelopment should decrease as the system becomes more stable and the fines are removed. (The sump was installed in September-October 2002 and redeveloped in March 2003 and April 2004. No subsequent redevelopment has been performed.)

Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.4.2 Routine Inspections and Maintenance of ITSS Pump System

The ITSS collects water from the area downgradient of the SPPTS treatment cells. Water collected in the sump is pumped uphill and directly into SPIN. Routine maintenance of the ITSS pump system is similar to that of the SPIN system. The ITSS pump is equipped with a timer which can be used to adjust the pump cycling.

Note **Do not adjust the duration of the “ON” cycle at the ITSS pump. Increasing the length of time the pump operates during each cycle will result in water overflowing SPIN.**

Water levels in ITSS are monitored remotely by checking the automated data transmission. Manual water level measurements may be required to troubleshoot problems with the ITSS pump or the automated data. Table 5 lists typical water elevations and depth to water in the sump. The pump in ITSS does not operate continuously; rather it cycles on periodically resulting in an oscillating water level visible on the automated data transmission graphs.

Note **If signs of rodent activity (e.g., nests, droppings, carcasses, or live rodents) are observed within any treatment system enclosures, do not enter the enclosure. Mouse droppings, saliva, and urine carry Hantavirus, which can cause a severe respiratory disease. Contact H&S immediately for instructions on proper handling and disposal.**

Manually Monitoring Water Levels in ITSS

[1] Remove the lid to the pump casing and, if necessary, carefully move the pump wires located in the top of the casing.

[2] Using a measuring tape or similar calibrated measuring device, measure the water level in each treatment cell. *Always measure from the mark on the eastern edge of the casing rim*. Measure to the nearest 0.01ft and document the result.

[3] Carefully place all wires in the top of the casing, and replace the lid.

IF manual water level measurements differ significantly from automated data output,
THEN water level transducer in ITSS should be recalibrated. See the RFWF for instructions.

IF the automated data indicate a consistently rising water level in ITSS with no evidence of pump operation (e.g. depth to water graph shows no oscillation and flow graph shows a flow rate of zero), and those data are confirmed to be accurate,
THEN the pump has malfunctioned. Refer to Section 3.4.2.3 for information on troubleshooting the pump.

IF the pump is operating (Section 3.4.2.1) and water levels in ITSS are continuously rising,
THEN adjust the timer to shorten the off cycle on the pump.

Note **Do not adjust the duration of the "ON" cycle at the ITSS pump. Increasing the length of time the pump operates during each cycle will result in water overflowing SPIN.**

IF water levels within ITSS remain elevated for more than 2 consecutive months after a precipitation event,
THEN notify management.

3.4.2.1 Checking the ITSS Solar Panel, Charging System, and Batteries

On a monthly basis, check the following on the electrical system:

[1] Check for loose or damaged wires, including checking the insulation on the wires. Animals often chew through insulation and wires.

[2] Make sure all equipment is securely mounted. High winds as well as temperature fluctuations can loosen mounting hardware.

[3] The green light on the pump controller (CU 200) should be on. Other warning lights on the controller should not be on.

On a monthly basis, check the following on the solar panels:

[1] The panels should be facing south and tilted at a pitch angle of approximately 40 degrees.

[2] Remove any equipment and vegetation that may be blocking the panel. Do not scratch the glass, and use care as the panels can get very hot through exposure to the sun.

[3] The surface of the solar panels should be clean. Light dust on the surface is acceptable, but no other soiling, including bird droppings. Do not scratch the glass, and use care as the panels can get very hot through exposure to the sun. (Note: The panels are in a fixed position and should not be moved during routine activities, including cleaning.)

IF the panels are more than dusty,
THEN rinse with clean water (i.e., tap, distilled, or deionized).

IF dirt is difficult to remove,
THEN wash with a wet paper towel or a wet soft cloth.

The batteries (as of January 2008) are Deka Dominator batteries, Model 8G8D. These deep-cycling batteries are made specifically for backup power for photovoltaic systems. Each 12-volt battery is sealed and "maintenance-free." Should replacement of the battery bank become necessary, comparable batteries shall be used. Additional information on the batteries is presented in The RFWF. The lid to the battery box should remain closed at all times except during inspection and repair. The batteries need to be inspected monthly for signs of corrosion and overcharging. These signs include the following:

- Is there corrosion at the terminals?
- Do the wires appear to be damaged or oxidized?
- Are the batteries bubbling?
- Is there moisture accumulation on the top of the batteries?
- Are the batteries bulging?
- Is the battery operating at full capacity?

IF there is evidence of damage or overcharging the batteries,
THEN contact management immediately. It may be necessary to contract an electrician to determine if repairs are necessary.

On a weekly basis, perform the following on the Xantrex charge controller:

[1] Check that there are no active faults or warnings. If a fault or warning is active, the default display will indicate this condition.

[2] From the output display screen (default screen if no warnings/faults are active), check that the output voltage (battery voltage) is between 48 and 55 volts.

[3] Press the down button and check that the input amps (solar amps) do not read zero.

[4] From the input display screen, press the down button twice more to check the charging status. The status should read "Bulk," "Absorb," or "Float."

[5] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.4.2.2 Checking the ITSS pump timer

The ITSS Pump operates on a timer, which is the small white box with dials located next to the pump controller. The timer has dials which control the on ("Ton") and off ("Toff") cycles. Each cycle has two dials. The small white dial controls the scale, and the larger blue dial controls the actual cycling. To determine the actual timer setting, multiply the lower number of the scale (to which the white dial is set) by the number to which the blue dial is set. For example, the "on" cycle should be set with a scale of 1 – 10 min. and the blue dial should be set to 3. This results in an "on" cycle of three minutes (1 X 3).

<u>On a monthly basis,</u> check the following on the timer:

[1] Ensure the timer is plugged in and operating. The green light should be flashing. The light will flash rapidly during an off cycle, and slowly during an on cycle.

[2] Ensure the on cycle is set to 3 minutes, and the off cycle is appropriately set for recharge into ITSS.

3.4.2.3 Troubleshooting the ITSS pump

If the pump ceases operation (as indicated by a constant depth to water in ITSS and a constantly zero flow rate), follow the instructions below.

[1] Ensure the on cycle of the timer is set to 3 minutes, and the off cycle is an appropriate value.

[2] Ensure the ITSS filter in the SPIN instrumentation vault is clear.

IF filter is clogged,
THEN follow instructions in Section 3.4.1.2 to clear filter

[3] Ensure the brass valves on the ITSS line in the SPIN instrumentation vault are in the "ON" position.

[4] Ensure the quick connect wire connections in the top of the ITSS pump casing are secure.

[5] Ensure the solar panels, charging system, and batteries are operating properly (Section 3.4.2.1).

[6] Ensure the pump controller is on. The light on the ON/OFF button should be green.

IF problem persists and pump will not operate
THEN notify management

3.4.3 Pump and Battery Replacement

Occasionally it may be necessary to replace the pump and/or battery bank at the SPPTS pump systems. Be sure to have all required equipment, supplies, and personnel available before initiating this activity. At SPIN, water will continue to collect in the groundwater intercept trench. At ITSS, an overflow line is present that will, in the event of overly high water levels, direct collected water to a gravel-filled gallery west of the Discharge Gallery. Because this overflow water is not treated, work should be completed before water enters the ITSS overflow line. If necessary, untreated water may be pumped from either of these sumps to the ground surface south of the groundwater intercept trench, as long as the requirements of Contact Record 2008-06 are followed.

3.4.3.1 Battery Replacement

Note **Because nominal battery voltages at these systems are less than 50 volts, lockout/tagout is not required. However, ensure that all personnel have read and signed the JSA for "Miscellaneous Electrical Work" prior to replacing the battery bank. All precautions should be taken to prevent electrical shock.**

[1] Turn the pump off. At SPIN, this will require turning the switch on the bottom of the silver pump controller to the "OFF" position. At the ITSS, this will require pushing the ON/OFF button; the light on the button will be red when the pump is off.

[2] Turn all breaker switches to the "OFF" position. At SPIN, this will be the red switch next to the pump controller. At ITSS, this will involve opening the breaker box and switching all three breakers to the "OFF" position.

[3] Carefully note the battery and wiring configuration. It will be important to wire the new batteries in an identical configuration.

[4] Detach the charge controller and telemetry wires from the battery terminals.

[5] Remove the thick wires connecting the battery terminals to one another.

[6] Remove the batteries from the battery enclosure.

Note **These batteries are extremely heavy. Do not attempt to move them alone. At SPIN, a minimum of 2 people is required to replace the batteries. At ITSS, a minimum of 3 people are required to remove the old batteries from the vault and to lower the new ones into the vault. Be sure to use proper lifting techniques.**

[7] Place new batteries into the enclosure, being sure to retain the same configuration as the old batteries.

[8] Re-attach the thick wires connecting the battery terminals to one another.

[9] Re-attach the charge controller and telemetry wires to the battery terminals.

[10] Double-check that battery configuration and wiring are correct and identical to the configuration prior to replacement activities.

[11] Turn all breakers to the "ON" position.

[12] Turn the pump back on.

3.4.3.2 Pump Replacement

Use the following procedure only if the pump in question is being replaced with one of the same model. If the new pump is a different model, a new pump controller will likely be necessary and pump replacement should only be performed by a qualified installer of solar pump systems.

[1] Prepare new pump for installation. Follow manufacturer supplied information included with new pump.

[2] Turn the pump off. At SPIN, this will require turning the switch on the bottom of the silver pump controller to the “OFF” position. At the ITSS, this will require pushing the ON/OFF button; the light on the button will be red when the pump is off.

[3] Turn all breaker switches to the “OFF” position. At SPIN, this will be the red switch next to the pump controller. At ITSS, this will involve opening the breaker box and switching all three breakers to the “OFF” position.

[4] Remove the lid to the pump casing and unplug the wire connectors, being sure to note the plug pairings.

[5] Carefully remove the pump by pulling up on the drop pipe, being sure not to damage the pitless adapter in the process.

Note **The SPIN pump is suspended beneath approximately 30 ft of drop pipe. Removing the SPIN pump will require some form of mechanical assistance. Consult management to determine the best method for removing the pump. Pulling the ITSS pump can be accomplished manually, but requires at least 2 people.**

[6] Cut the drop wire just above the splice at the pump. Be sure to note which wires are spliced to one another.

[7] Remove pump from drop pipe.

[8] Attach new pump to drop pipe, being sure to include any manufacturers’ recommended thread sealant.

[9] Strip new wire ends on the drop wire.

[10] Make the new wire splices identical to the previous configuration.

[11] Appropriately seal the splices to ensure a waterproof connection. Follow manufacturers’ recommendations.

[12] Using cable ties, secure the pump wire and lower end of the drop wire to the drop pipe.

[13] Carefully lower the pump into the pump casing, ensuring a good connection is made at the pitless adapter.

[14] Re-connect the plug connections identical to the previous configuration.

[15] Turn all breakers to the “ON” position.

[16] Turn the pump on and verify that water is flowing through the associated piping in the SPIN instrumentation vault.

Note **Because the ITSS pump is on a timer, it may not pump when the ON/OFF button is pushed. To verify that the pump is wired correctly, unplug the timer before turning the pump on. Once it has been verified that the pump is operating correctly, turn the pump off, re-attach the timer, and turn the pump back on.**

[17] Make sure the pump shuts off when the water level reaches the low-level shutoff. At SPIN this should be approximately 28 ft below top of casing, and at ITSS this should be approximately 12.5 ft below top of casing.

[18] Once it has been determined the pump is operating correctly, place the wires back in the top of the pump casing and replace the lid.

[19] Closely monitor the automated data transmission over the next few days to ensure pump is operating correctly.

3.4.4 SPPTS Media Replacement

The need to replace the media in the SPPTS will be evident from the inability of the system to remove nitrates and/or uranium, or by water backing up in the system due to clogging or biofouling. Removal of media is generally similar to the media replacement described for other treatment systems; however, the media at the SPPTS is buried beneath approximately 12 to 15 ft of overburden and is, therefore, not easily accessible. (This is a major reason for the additional upgrades that will be performed to the system in 2009 and 2010. Those upgrades are not addressed in this version of this document, but will be discussed in future versions.)

To access the treatment cells, the upper soil layer shall be removed and stockpiled. Then the woodchip fill over the treatment cells will be removed and stockpiled. These materials can be reused following media replacement. Management and disposal of the underlying treatment media and any associated materials shall be determined by Environmental Compliance staff; they may need to be handled as low-level waste.

The following steps describe media replacement in the East Cell. Similar steps would be undertaken to replace the media in the West Cell; the West Cell includes several significant differences, as summarized below. Table 6 lists the cell dimensions and material requirements.

- The West Cell uses organic media/ZVI mixture instead of the East Cell's gravel/ZVI mixture.
- The distribution gallery in the West Cell is configured differently, as shown on Drawing 51649-0401 in Appendix B.
- The distribution gallery may be reused if not damaged, but shall be connected to the influent port at the wall via a flexible connection that will allow for significant settling of the media (i.e., the line feeding the distribution gallery should allow the entire gallery assembly to drop at least 3 ft vertically as the media settles).

Follow requirements for permit-required confined space entry for any entry into the treatment cells or metering manhole. These hazards shall be addressed prior to entry. Safety personnel may require use of a combustible gas indicator for entry.

Assemble the following tools, materials, and equipment as required by the estimated volume of material to be removed:

- Erosion control materials such as straw wattles or silt fence;
- Aluminum or fiberglass extension ladder with an extended length of at least 25 ft;
- Shovels;
- Logbook;
- Standard garden cultivator rake or equivalent;
- Pry bars and other manual tools for breaking up crust/scraping walls clean;
- Air compressor, chippers or air hammers, and/or other tools for breaking up crust (it is not likely this will be needed, but there is some potential);
- Excavator with sufficient reach to remove material from cell;
- Plastic sheeting;
- Gravel;
- Concrete mixer or similar mixing device;
- ZVI;
- Pump capable of draining treatment cell along with necessary hoses;
- Dump truck or other means of containment and transport for spent material;
- Plumber’s snake (at least 50 ft long);
- Portable generator;
- All equipment required for a permit-required confined space entry;
- PVC piping and well screen;
- Utility knife;
- Water storage tank;
- Tape measure; and
- HDPE plastic sheeting.

Table 6. Depth, Thickness, and Volume of the SPPTS Treatment Cells

Parameter	Quantity	Unit
East Cell		
Width of Cell	10.5	Feet
Length of Cell	17	Feet
Cross-Sectional Area	178.5	Square Feet
Height of Gravel Drainage Layer	1	Foot
Volume of Gravel In Drainage Layer	178.5	Cubic Feet
Height of ZVI/Gravel Mixture	8.8	Feet
Thickness of ZVI/Gravel Mixture	7.8	Feet
Volume of ZVI/Gravel Mixture	1398.3	Cubic Feet
Percent ZVI (by volume)	15	%
Percent Gravel (by volume)	85	%
Total Gravel Volume	1188.5	Cubic Feet
Total ZVI Volume	209.7	Cubic Feet
Height of Gravel Distribution Layer (Cell Height)	12.0	Feet
Volume of Distribution Layer	565.3	Cubic Feet
West Cell		
Width of Cell	31.5	Feet
Length of Cell	17	Feet
Cross-Sectional Area	535.5	Square Feet
Height of Gravel Drainage Layer	1	Foot
Volume of Gravel In Drainage Layer	535.5	Cubic Feet
Height of ZVI/Organic Media Mixture	10	Feet
Thickness of ZVI/Organic Media Mixture	9	Feet
Volume of ZVI/Organic Media Mixture	4,820	Cubic Feet
Percent ZVI (by volume)	10	%
Percent Organic Media (by volume)	90	%
Total Organic Media Volume	4,338	Cubic Feet
Total ZVI Volume	482	Cubic Feet
Height of Grade 1 Wood Chips (Cell Height)	12.0	Feet
Thickness of Grade 1 Wood Chips	2	Feet
Volume of Distribution Layer	1,071	Cubic Feet

Perform the following steps:

[1] Establish erosion controls downgradient of the area that will be disturbed by the construction activities, as required.

[2] Protect metering manhole, PZs, wells (including collection well, SPIN), valves, and solar array/battery system outside of cell with additional riser pipes, barricades, or equivalent and appropriate methods if in the way of operations.

[3] Establish appropriate waste management process in coordination with Environmental Compliance staff.

[4] Establish waste management area lined with plastic sheeting upgradient (south) of the treatment cell. Design area to be large enough to accommodate all removed media that will be disposed of as waste. Because of the sharp edges and abrasive nature of the iron/gravel media, consider multiple layers of plastic or other appropriate means of

improving protection. Install wattles or berms around waste management area to help contain waste piles in the event of precipitation.

[5] Establish stockpile area for wood chip and soil overburden, and line with plastic sheeting. These materials should be segregated to the extent feasible (i.e., separate soil and wood chip piles, both separated from the waste management area) and replaced as overburden on new media.

[6] Remove guardrails to allow better access to the SPPTS East Cell.

[7] Seal off vent openings to prevent material from falling into pipes.

[8] Check valves to make sure system is configured to bypass the East Cell as follows: Close valves V-103 (transfer line), V-201 (East Cell inlet), and V-202 (East Cell outlet). Open valves V-101 (West Cell inlet) and V-102 (West Cell outlet). Valve locations are shown on as-builts in Appendix B and are labeled in the field.

[9] Measure and record the depth to water in the cell via the vent risers.

[10] **IF** required,
THEN remove water by placing a pump or pump intake into the easternmost (effluent) vent riser of the East Cell, just south of valve V-202. Place pump discharge line into metering manhole. (This water has been treated.) Remove as much water as possible.

[11] **IF** water flows over the wall between the cells during media removal,
THEN close the influent valve into the treatment cell (valve V-101) and shut off the solar-powered pump in SPIN.

[12] Remove topsoil and wood chips down to the top of the East Cell. ***The top of the East Cell media is approximately 14 ft 9 inches below the top of the south wall of the treatment system.*** As much as possible, keep topsoil and wood chips segregated from each other for reuse as fill; place on plastic liner in designated stockpile area.

[13] Pull back or remove the HDPE sheet. Remove wood chips under the HDPE and dispose as waste.

[14] Continue to remove gravel and gravel/iron mixture. Remove the distribution piping when it is encountered at the base of the coarse gravel layer. Place removed material in waste storage area.

Note **Piping needs to be separated/cut off with at least 6 inches remaining inside the tank (measured from the inside surface of the wall) so that new piping can be added.**

[15] Break up hardened media either using an excavator, backhoe with hoe ram attachment, or hand-held equipment.
IF using hand-held equipment,
THEN place the ladder into the treatment cell and secure. Use air hammers with chisel attachments (or equivalent) to break away remaining material from wall of treatment cell and loosen other material as needed.

[16] Using excavator/backhoe bucket or similar device, remove loose media from the cell. Stage removed material in waste storage area or load directly into waste containers or

dump trucks for disposal. Repeat media removal steps as needed to remove all of the material out of each treatment cell. Continue water removal as necessary.

[17] Remove remaining iron along with gravel at the bottom of the treatment cell. Remove PVC piping from bottom of the cell. Stage for removal as waste.

Note **Piping needs to be separated/cut off with at least 6 inches remaining inside the tank (measured from the inside surface of the wall) so that new piping can be added.**

[18] Measure the height, width, and length of the treatment cell and the height from the bottom of the cell to the inlet and outlet piping. Record in logbook or on maintenance form.

[19] While the treatment cell is empty, push a snake or other suitable flexible object through the influent and effluent lines as far as possible to remove any debris. Use care so as not to damage external PVC piping and valves.

[20] Place a 3-inch-deep coarse gravel layer in the bottom of the cell. Rake this gravel drainage layer so that it is level.

[21] Inspect PVC stubs remaining from cell influent and effluent lines, modify cut ends as necessary to ensure new lines will couple smoothly.

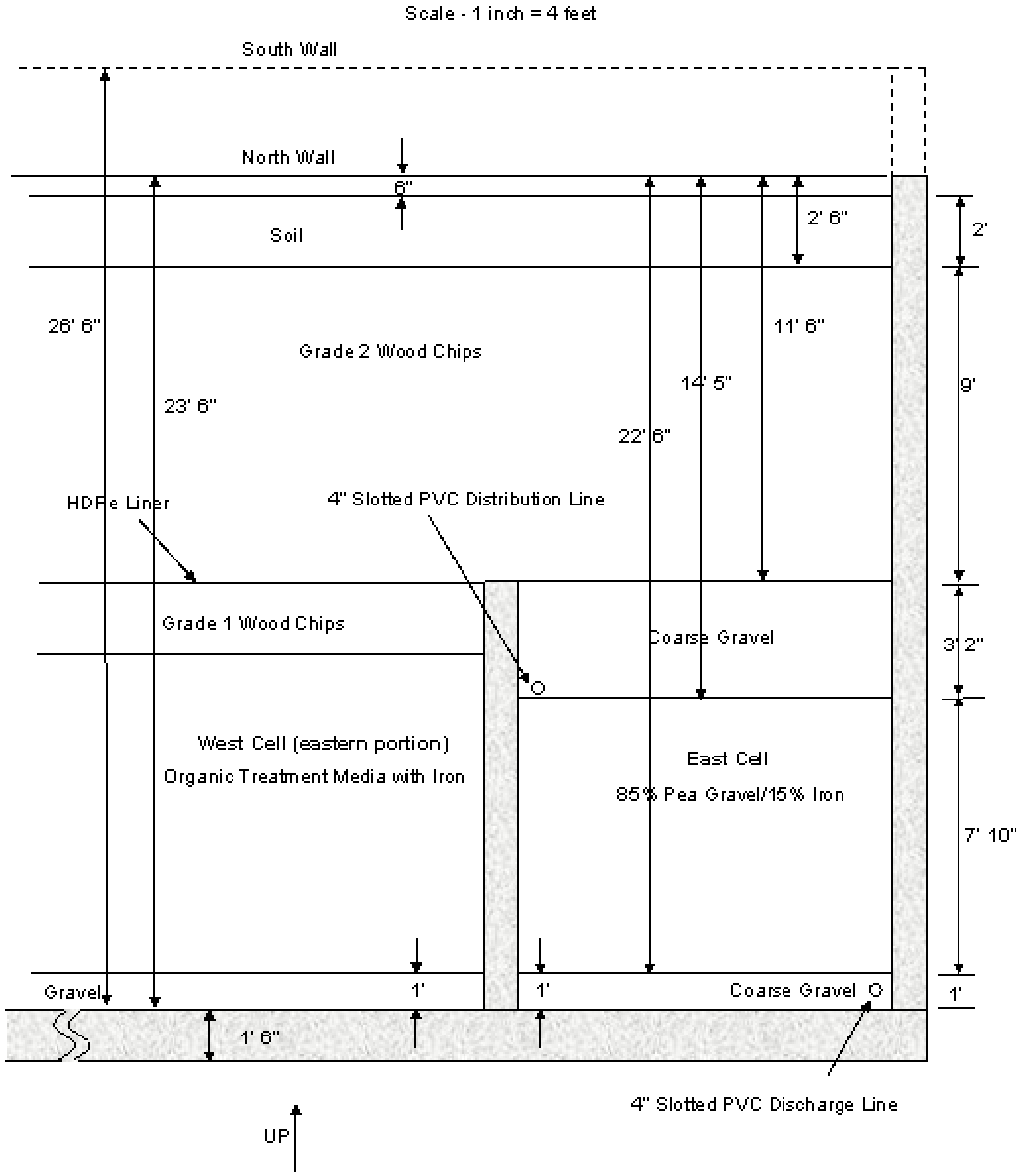
[22] Assemble discharge line using machine-slotted or perforated 4-inch Schedule 80 PVC pipe as shown in Drawing 51649-0401 in Appendix B. If slots or perforations are not finer than the fine fraction of the ZVI/gravel mixture, the pipe should be wrapped or sleeved in permeable fabric (such as heavy-duty landscaping fabric) to prevent clogging of the discharge line, because a clogged line would require repeating this entire process. Apply primer followed by PVC cement to the ends of pieces of pipe to be joined. Connect new line to stub of existing line using a 4-inch coupler (socket-to-socket connector).

[23] Place the remainder of the coarse gravel in the bottom of the cell to the depth listed in Table 6. Rake the gravel so that it is level.

[24] Add the mixture of 15 percent ZVI/85 percent pea gravel (by volume) in lifts, raking each lift so that it is level. Continue until media reaches the height listed in Table 6 and as shown on Figure 5. The ZVI and gravel shall be completely mixed in a concrete mixer or similar mixing device and the first several feet of this mixture shall be placed carefully to minimize disruption of the coarse gravel drainage layer.

[25] Place 2 inches of coarse gravel at the top of the ZVI/gravel mixture.

[26] Assemble the distribution piping using machine-slotted or perforated 4-inch Schedule 80 PVC pipe as shown in Drawing 51649-0401 (Appendix B) using PVC primer and cement as described above. Connect to existing PVC stub using a 4-inch coupler. Place the distribution piping as shown on Drawing 51649-0401 in Appendix B.



Note: Wood chip types are suggested, but are not critical. Any bulk wood chips will be satisfactory. The objective is to provide insulating overburden without excessive weight that might damage the internal plumbing or cause excessive compaction of the organic media.

Figure 5. Cross-Section of East Cell and Easternmost Portion of West Cell Looking North

[27] Open valves V-101 (West Cell inlet), V-202 (East Cell outlet) and V-103 (transfer line). Make sure valves V-102 (West Cell outlet) and V-201 (East Cell inlet) are closed. Check and make sure solar-powered pump is on. Check to make sure water is flowing in.

[28] **IF** water is not flowing into the cell or is flowing slowly,
THEN additional nonchlorinated water may be required to fill the cell. Check the water level in SPIN to confirm there is a sufficient supply of groundwater for the pump (see Table 5), and, if there is, periodically (over the course of an hour or so) check the water levels in the West Cell via the vent risers to confirm the water level in that cell is rising.

Insufficient groundwater will require addition of nonchlorinated water to fill the cell up to the distribution line.

Any water added to the system shall not be chlorinated.

[29] Verify water flows out the flume in the metering manhole.

[30] Add the rest of the gravel to the level listed in Table 6 and level the surface as shown on Figure 5. Add this gravel carefully to avoid damaging the PVC distribution piping.

[31] Place the original HDPE or new plastic sheeting to fit completely over the East Cell as shown on Figure 5. (The original sheet may be repaired with cargo pit tape or equivalent if cuts are less than 2 ft long.)

[32] Replace the wood chips stockpiled from above the HDPE sheeting as shown on Figure 5. Level the surface.

[33] Replace topsoil that was stockpiled and level the surface.

[34] Replace the railings.

[35] Manage/dispose of all wastes properly. Remove all miscellaneous trash, unnecessary erosion controls, and so forth to restore the area.

[36] Immediately document routine operations in the Monthly Inspection Log (Appendix F), and subsequently update the Rocky Flats maintenance log on the Condor server after returning to the office.

3.5 Present Landfill Treatment System

The PLFTS requires much less in the way of maintenance than the other three systems at the Rocky Flats Site (RFS) because it is much simpler, consisting of an engineered aeration surface. Most of the activity at the PLFTS is in the form of inspections and routine sample collection. Refer to the PLF Monitoring and Maintenance (M&M) Plan (DOE 2008) for details on required PLF inspections and sampling. The activities below should be considered suggestions supporting the regulatory-required activities in the M&M Plan, as the PLFTS has no specific maintenance requirements other than inspections.

3.5.1 PLFTS Inspection and Maintenance

Inspect the system when performing an inspection of the PLF or more frequently if conditions indicate this is warranted. Perform the following:

[1] Look for cracks in the north and south manholes and the treatment unit (surface and 10 steps).

    a. Document observations.

    b. If any cracks are found, notify management immediately.

[2] Look for any blockage of the influent and effluent pipes. These include the GWIS influent pipes (two), east face strip drain influent pipe, north and south manhole effluent pipes, and treatment unit effluent pipe.

a. Document observations.

b. If any blockage is found, remove it if this can be easily and safely accomplished. If additional effort, planning, or equipment is required, notify management.

[3] Confirm all grating is present and in good condition.

a. Document observations.

b. Replace any damaged or missing grating with equivalent material.

[4] Look for excessive erosion along the pathway from the treatment unit effluent pipe to the Landfill Pond.

a. Document observations.

b. If excessive erosion is evident, notify management.

4.0 Documentation of Maintenance

While in the field, maintenance to the groundwater treatment systems shall be immediately documented in the Monthly Inspection Log for Rocky Flats Groundwater Treatment Systems (Appendix F). Field personnel may choose to utilize a different method to record operations in the field (e.g., log book, PDA); regardless of the method employed it is important to include all information contained in the Monthly Inspection Log (Appendix F). Additionally, the Rocky Flats maintenance log on the Condor server (\\Condor\Projects\ESL\VDV\SOARS\User Files\Activity Logs) shall be updated upon returning to the office. A single electronic maintenance log for all three similar systems will be kept to document system checks and repairs.

Completed maintenance logs will be kept on file (both electronic and hard copy) with the manager responsible for these systems. In addition to providing a maintenance record that can support troubleshooting and compliance, this information also will be used to interpret the flow meter data.

5.0 References

DOE (U.S. Department of Energy), 2008. *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan, U.S. Department of Energy Rocky Flats Site*, March.